

## **Insect Control in Field Crops**

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Make sure that a definite insect problem exists before applying insecticides to a crop. Use recommended thresholds as a guide when making spray decisions. If you are unable to make this determination, contact your local county Extension office or state Extension Specialist for advice or assistance. Use pesticides only when necessary.

## **Grain Crops, Soybeans, Forages**

### **Cultural Control Methods**

Cultural control methods are powerful tools in managing insect pests. In many instances, growers who follow accepted cultural practices can expect little trouble from insect pests. Some of the most beneficial cultural methods for problem insects include:

#### **Crop rotation**

Crop rotation is an inexpensive and effective way of controlling most below ground pests. Rotations that include grass and non-grass crops (e.g., legumes), and rotations of at least two years are best. Multiyear rotations are most effective for wireworm because this insect may take several years to complete development.

#### **Tillage**

Conventional tillage is an effective way to manage multiple pests. Slugs, wireworms (eggs and young larvae), cutworms, white grubs, corn earworm, peanut burrower bug, and other pest populations will be reduced by disking in winter or early spring. Keep in mind that tillage does not always benefit pest management and may encourage some insect populations.

#### **Planting date**

Timely planting will effectively limit pest pressure late-season when insect populations have had time to build over the summer. Rapid germination and early vigor will enable plants to outgrow seedling injury.

#### **Hybrid/variety selection**

Uniform stand and healthy plants will minimize economic impact of insect pests. Early maturing varieties will reduce insect injury and avoid some species altogether. Some crop varieties offer increased tolerance to insects and microbial pests. Genetically modified Bt corn hybrids protect against a suite of above and below ground insect pests. The Handy Bt Trait Table published by Chris DiFonzo at Michigan State University provides a list of corn trait names and their insect protection benefits - <https://www.texasinsects.org/bt-corn-trait-table.html>. Western corn rootworm has evolved resistance to several Bt traits in Virginia. Virginia Tech specialists recommend planting hybrids with two or more rootworm Bt traits when rotation out of corn is not possible or practical. To minimize selection pressure, and future resistance problems, follow all refuge planting requirements.

## *4-2 Insect Control in Field Crops: Grain Crops, Soybeans, Forages*

### **Chemical Control**

Insecticides are sometimes necessary even when using proper cultural control techniques. Recommendations in this publication deal primarily with chemical control. It is critical to worker safety, efficacy of materials, and the marketability of crops to follow all label instructions. Most insecticides will kill honey bees and pollinating insects if applied to a crop in bloom. Label instructions will contain pollinator protection statements when applicable.

## **Forages: Alfalfa and Other Legumes**

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### **Alfalfa Weevil**

There are two cultural control tactics that can be utilized to reduce alfalfa weevil damage. In the late fall, remove the alfalfa for hay or by grazing. This removes the overwintering egg-laying sites for the adult weevils, and will help reduce the number of alfalfa weevil larvae attacking the crop the following spring. Early harvest can sometimes be used in the spring instead of insecticide sprays, if the crop has obtained sufficient growth before larval feeding damage becomes severe.

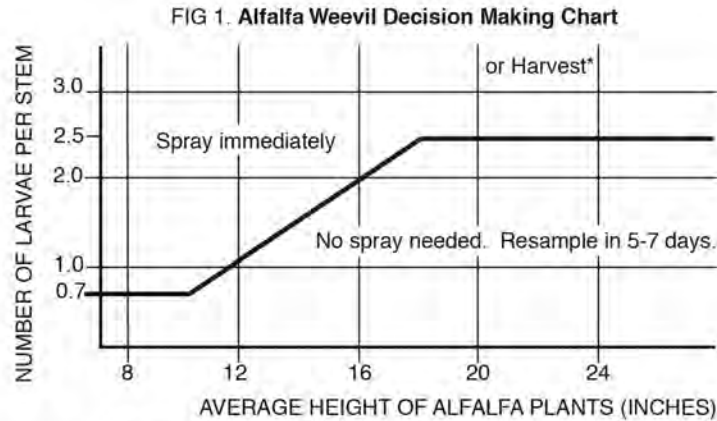
### **Sampling to Determine Whether Control Measures Are Needed**

When the alfalfa starts growing in the spring, walk through the field at least once a week and closely inspect alfalfa tips for feeding injury. When damage and weevil larvae are observed, systematic sampling should be conducted (using the procedure described below) at least once weekly (or more frequently if weevil populations are approaching the action threshold) until the fields are sprayed, harvested, or the weevil season is over. If you are required to spray early and you use a short-residual insecticide, wait 2 to 3 weeks after spraying and resume the sampling program. Insecticide spray failures have been reported following periods of cooler temperatures. This may be the result of reduced activity by the insect (i.e., weevils are not eating treated material nor touching treated surfaces) as opposed to insecticide resistance. Larvae often feed in protected areas of the plant, ensure coverage by using adequate spray volume and pressure. Please report suspected cases of insecticide resistance to your local County Agent or Extension Specialist.

Equipment needed to sample a field includes a 3- to 5-gallon bucket, a shallow dishpan, a clipboard with pencil and paper, and tape measure or folding rule. Mentally divide the field into 6 equal sections and walk to the approximate center of the first section. Randomly pull 10 entire stems and place them, tip end first, into the bucket. Be careful to hold the bucket under each stem tip as it is pulled to catch any weevil larvae that may fall off. When the ten stems are collected, grasp them firmly by the base and shake them vigorously against the sides of the bucket for 5 to 10 seconds. As you are shaking the stems, hold the clipboard over the top of the bucket to prevent larvae from being thrown out. Pour the contents of the bucket into the shallow dishpan and count the total number of all weevil larvae.

Randomly select two of the stems from your sample and measure their lengths. Record the number of larvae and the two stem lengths on your clipboard. Walk to the approximate center of the other 5 sections of field and repeat the sampling procedure. Note: in a fairly large field (greater than 20 acres) you may wish to take a few extra samples to improve your sampling accuracy. When you have finished the field, total the larvae and stem lengths for all six sample sites. Determine the average number of larvae/stem by dividing the total by 60 (10 stems at 6 sites) and the average stem length by dividing by 12. Then refer to the decision-making chart, Fig. 4.1. Plot your average number of larvae/stem against stem height. If the point falls near or above the economic threshold line, either harvest or treat the field with a short-residual insecticide. If the point falls below the threshold line, no control measures are recommended; sample again in 5 to 7 days. More frequent sampling may be desired if population levels are approaching the threshold and daily temperatures are above 70° F. **Note: these thresholds are intended for alfalfa growing under adequate fertility and soil moisture conditions. Under drought stress conditions, when alfalfa is growing slowly, the threshold should be lowered by about 0.5 weevil per stem.**

## 4-4 Insect Control in Field Crops: *Forages: Alfalfa and Other Legumes*



\* If harvested without spraying, inspect stubble closely after hay is removed for presence of weevils and feeding damage. A stubble spray may be required.

Fig. 4.1. Decision-making chart for determining the need to apply insecticides for alfalfa weevil control.

### **Spray or Harvest for Weevil Control?**

In weevil control zone A, roughly east of the Blue Ridge Parkway, (Fig. 4.2), good survival of overwintering weevil eggs and warm temperatures often result in early larval hatch, causing damage when alfalfa is less than 6 inches tall. Population surveys should be initiated early. If 50 percent of the tips have been damaged and the alfalfa is less than 6 inches tall, spray as soon as possible. In zones B and C, however, the need to control alfalfa weevil varies from year to year, and field sampling should be conducted to determine population levels. Harvesting often can be used as an effective weevil control tactic, if enough growth is present to justify the harvesting process. Yield sacrificed in the first cutting by early harvest will be compensated in 2nd and subsequent cuttings. Cutting alfalfa early assures high quality hay with high protein and TDN, and reduces chance of losing hay to rainy weather later in the season. Early cutting also gives the second growth of alfalfa a head start before the potato leafhopper adults appear in early June. The decision to cut or spray should be based on favorable hay-making weather and time scheduling with other farm operations. If hay is cut before the bud stage in the first cutting, second and subsequent cuttings should be allowed to reach 0.10 bloom before cutting to insure adequate storage of root carbohydrates. Alfalfa may be harvested early only once during the growing season without reducing stand density or longevity.

### **Determining the Need for Stubble Sprays**

If insecticide sprays are used prior to harvest of the first cutting, stubble sprays are seldom necessary. However, if no sprays have been used, or if the field has been cut early because of a heavy weevil infestation, stubble sprays **may** be necessary. Within a week after the hay has been removed from the field, closely inspect the growing shoots of the alfalfa for the presence of larvae or signs of feeding. No formal sampling plan or economic thresholds are available for this crop stage, but, generally, if weevil larvae are easily found, shoot damage is occurring, or regrowth appears delayed, a stubble spray should be applied. Adult weevils can occasionally cause severe damage to regrowth, but because the adult weevils usually hide under the alfalfa crown during the day, they are not easily seen.



*Fig. 4.2. Alfalfa Weevil Control Zones*

*The dividing line between Zone A and Zone B is roughly the Blue Ridge Parkway.*

*The line dividing Zone B and Zone C roughly follows the county lines.*

**Table 4.1 - Recommended Insecticides for Control of Alfalfa Weevil Larvae**

<b>Insecticide (Formulation)</b>	<b>Amount active ingredient per acre</b>	<b>Amount product per acre</b>	<b>Time limits: days before harvest</b>	<b>Remarks</b>
beta-cyfluthrin (Baythroid XL)	0.0125-0.022 lb	1.6-2.8 oz	hay harvest: 7 grazing: 7	<b>RESTRICTED USE.</b> Maximum product allowed per cutting is 5.6 oz/A. Maximum product allowed per crop season is 22.4 oz/A.
carbaryl (Sevin 80 Solupak) (Sevin 4F)	1.5 lb 1.5 lb	1.875 lb 1.5 qt	hay harvest: 7 grazing: 7	Highly toxic to bees. Avoid spraying weeds in bloom or alfalfa beyond 10% bloom.
dimethoate (Dimethoate 4EC)	0.25-0.5 lb	0.5-1.0 pt	hay harvest: 10 grazing: 10	Do not apply within 10 days of harvest or pasturing. Make only 1 application per crop cycle or cutting. Effective only on cutting to which applied. Do not apply if bees are visiting the area to be treated when crops or weeds are in bloom. Apply no more than three applications per year.
indoxacarb (Steward EC)	0.065-0.11 lb	6.7-11.3 oz	hay harvest: 7 grazing: 7	Apply no more than once per cutting. A total of 45 oz/A may be applied/season.
lambda-cyhalothrin (Karate Z [2.08EC]) (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	forage harvest: 1 hay harvest: 7	<b>RESTRICTED USE.</b> Apply as required by scouting. <b>Ground application:</b> use 10 to 20 gal water/A. <b>Aerial application:</b> use 2 to 10 gal water/A. Apply in sufficient water for full coverage. Do not apply >0.12 pt/A/cutting. Do not apply >0.48 pt/A/season.

## 4-6 Insect Control in Field Crops: Forages: Alfalfa and Other Legumes

**Table 4.1 - Recommended Insecticides for Control of Alfalfa Weevil Larvae (cont.)**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
malathion (Malathion 5EC) (Malathion 57EC)	1-1.5 lb	1.5-2.0 pt 2 pt	0 0	Spray may be applied by air or ground equipment. Dilute application: use 20 to 60 gal water/A. Concentrate application: use ≥5 gal water/A.
methomyl (Lannate LV 2.4)	0.9 lb	3.0 pt	hay harvest: 7 grazing: 7	<b>RESTRICTED USE.</b> 48 hour re-entry interval. Also labeled for beet armyworm.
zeta-cypermethrin (Mustang Maxx)	0.014-0.025 lb	2.24-4.0 oz	cutting/grazing: 3 seed harvest: 7	<b>RESTRICTED USE.</b> Minimum 7 days between applications. Maximum 0.025 lb AI/cutting. Maximum 0.075 lb AI/season.

Note: to avoid injury to honey bees, do not apply insecticides during bloom.

## Potato Leafhopper

Spring-planting alfalfa with a companion crop of oats will help prevent soil erosion, and also reduce potato leafhopper infestations in the first summer cutting of alfalfa.

### Sampling Methods and Action Thresholds

Although several natural enemies prey upon potato leafhoppers in alfalfa, damaging levels of leafhopper are often reached, requiring insecticide application or harvest management. Leafhopper infestations are highly variable from field to field and from year to year; therefore, monitoring of individual fields is required for effective pest management decision-making. Leafhoppers are most easily sampled using a standard 15-inch diameter sweep net. At each of 6 randomly selected sites in a field, take 10 pendular sweeps with the net (swinging it back and forth in front of you) as you walk. One sweep equals one stroke of the net. After the last sweep, quickly grab the net to prevent insects from escaping. Carefully unfold the net, working your way toward the bottom. Count the number of leafhopper adults and nymphs as they emerge and leafhoppers in the bottom of the net. In fields with high leafhopper infestations, many leafhopper nymphs can be seen on the top and edge of the sweep net before the net is opened to examine the contents. Include these in your count. At each sample site, also measure and record the lengths of two randomly selected stems.

Record the total number of leafhoppers for all 6 sites and divide by 60 to determine the number of leafhoppers per sweep. Divide the total stem length by 12 to estimate average stem length. Then go to the Decision Making Chart shown in Fig. 4.3.

## **Using the Decision Making Chart**

(Fig. 4.3) From the average number of leafhoppers per sweep and the average height of the plants, draw horizontal and vertical lines until they intersect. If the intersection point is above the treatment line, spray or harvest (see below) as soon as possible; if the intersection falls below the line, resample in 5 to 7 days. As can be seen from this chart, the economic threshold is variable, depending on plant height.

For example, if you collected 30 leafhoppers in 60 sweeps for an average of 0.5 leafhoppers per sweep, and your average plant height was 4 inches, spraying would be indicated by the chart. If your average plant height was 12 inches for the same leafhopper count, no spray would be indicated. Keep in mind that this decision-making chart is intended for general use, and individual fields may vary considerably in plant response to the leafhopper feeding depending on soil moisture, fertility, and cultivar.

## **Spray or Harvest?**

Alfalfa should be harvested whenever the crop is in 10 percent or more flower regardless of leafhopper levels. Insecticidal control is most effective if applied early in the crop's growth (assuming leafhopper densities are above the economic threshold), since the spray will protect the alfalfa during the most susceptible stage of growth. As the alfalfa grows in height, the economic return on investment for insecticidal control is reduced but can still be justified if damaging population levels are present. Beyond a crop height of 14 inches, the value of insecticidal control becomes marginal, since considerable clogging of the plant's vascular tissue will have already occurred.

If plants are greater than 14 inches tall and leafhopper numbers are above the treatment threshold (see Decision-Making Chart), two management options are recommended. If the leafhopper count is above the treatment line but less than 2.3 per sweep, and the crop is showing 80 percent or more bud and less than 10 percent flower, harvest as soon as weather conditions are favorable. If the crop is not yet flowering, wait 7 to 10 days, then harvest. If the leafhopper count is greater than 2.3 per sweep, harvest as soon as the alfalfa shows 25 percent bud. Harvest as soon as possible if considerable damage has already occurred.

Harvesting will remove the damaged stems and allow new growth to begin. Newly-planted fields established in the spring are often so severely stunted by potato leafhoppers that harvesting would not produce a significant amount of hay. The crop should still be clipped to remove weeds and the damaged plants.

## **Determining the Need for Stubble Sprays**

Harvesting alfalfa has been shown to kill most potato leafhopper nymphs and many adults. The adults are highly mobile and most adult leafhoppers surviving harvest will leave the field. Even though high numbers of leafhoppers may be present in the field prior to cutting, stubble sprays are not necessarily needed to protect the next cutting. Ideally, the alfalfa should be sampled with a sweep net (as described above) about a week after harvest, or as soon as the alfalfa starts to grow back. If leafhoppers are present at levels greater than 0.4/sweep, spraying is recommended. If sampling the regrowth is not feasible, and high numbers of leafhoppers were present before harvest, a stubble spray on the regrowth may be a good protective measure, especially if green alfalfa was left in the field following harvest. For best results, wait about 5 to 7 days after harvest, or until 4 to 6 inches of new growth has appeared.

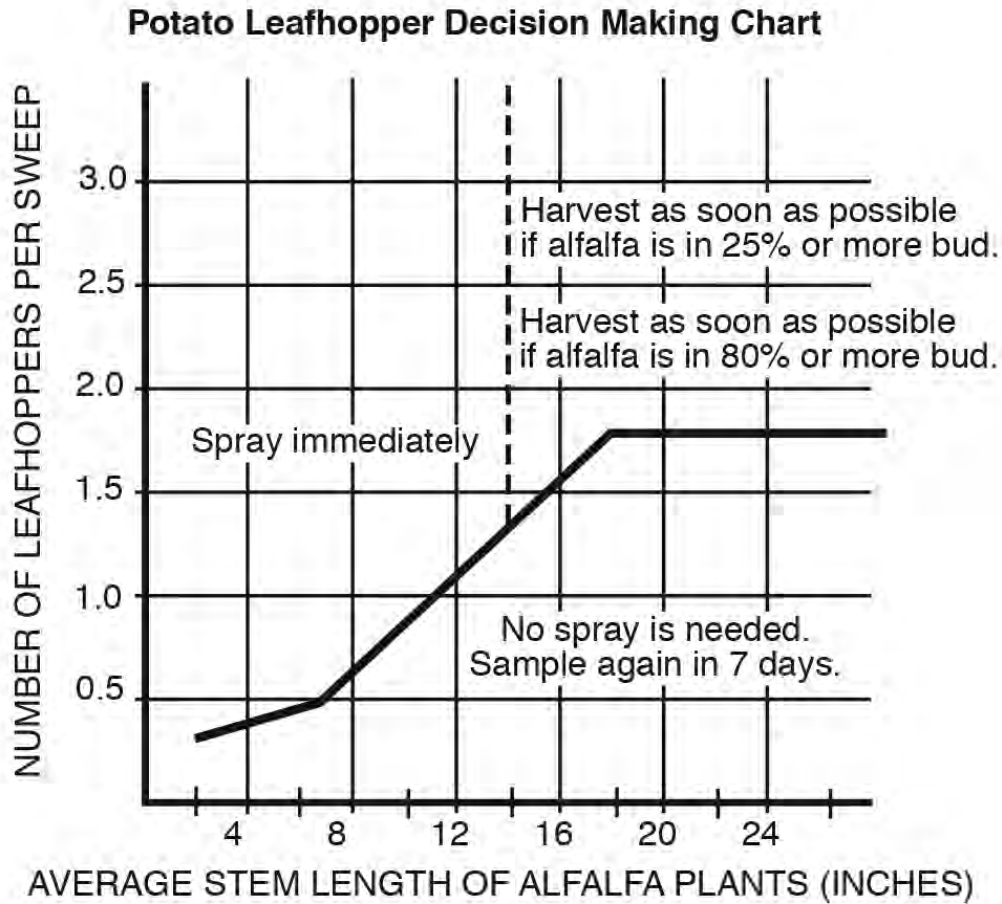
## 4-8 Insect Control in Field Crops: Forages: Alfalfa and Other Legumes

**Table 4.2 - Recommended Insecticides for Control of Potato Leafhopper**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.0065-0.0125 lb	0.8-1.6 oz	hay harvest: 7 grazing: 7	<b>RESTRICTED USE.</b> Maximum product allowed per cutting is 5.6 oz/A. Maximum product allowed per crop season is 22.4 oz/A.
dimethoate (Dimethoate 4EC)	0.25-0.5 lb	0.5-1.0 pt	10	Dimethoate also will control aphids and grasshoppers. Make only one application/cutting.
carbaryl (Sevin 80 Solpak) (Sevin 4F)	1.0 lb 1.0 lb	1.25 lb 2.0 pt	hay harvest: 7 grazing: 7	Highly toxic to bees; avoid spraying weeds in bloom or alfalfa beyond 10 percent bloom. May cause temporary bleaching of alfalfa foliage.
indoxacarb	0.09-0.11	9.2-11.3 oz	7	Suppression only. Apply no more than 11.3 oz per cutting.
lambda-cyhalothrin (Karate Z [2.08EC]) (Warrior II [2.08EC])	0.015-0.025 lb	0.96-1.60 oz	forage harvest: 1 hay harvest: 7	<b>RESTRICTED USE.</b> Apply as required by scouting. <b>Ground application:</b> use 10 to 20 gal water/A. <b>Aerial application:</b> use 2 to 10 gal water/A. Apply in sufficient water for full coverage. Do not apply >0.12 pt/A/cutting. Do not apply >0.48 pt/A/season.
malathion (Malathion 5EC)	1.0-1.5 lb	1.5-2.0 pt	0	Spray may be applied by air or ground equipment. <b>Dilute application:</b> use 20 to 60 gal water/A. <b>Concentrate application:</b> use ≥5 gal water/A.
zeta-cypermethrin (Mustang Maxx)	0.014-0.025 lb	2.24-4.0 oz	cutting/grazing: 3 seed harvest: 7	<b>RESTRICTED USE.</b> Minimum 7 days between applications. Maximum 0.025 lb AI/cutting. Maximum 0.075 lb AI/season.

Note: do not wait until yellowing occurs. Materials should be used as a preventative treatment after leafhoppers first appear.





*Fig. 4.3. Decision-making chart for determining the need to apply insecticides for potato leafhopper control.*

## Grasshopper

**Table 4.3 - Grasshopper**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.0155-0.022 lb	2.0-2.8 oz	hay harvest: 7 grazing: 7	<b>RESTRICTED USE.</b> Maximum product allowed per cutting is 5.6 oz/A. Maximum product allowed per crop season is 22.4 oz/A.
chlorantraniliprole (Prevathon)	0.027-0.067 lb	8-20 oz	0	Add methylated seed oil (MSO) at the rate of 1 gallon per 100 gallons of spray volume. Target spray at nymph populations and ensure adequate coverage. Feeding should stop almost immediately, but it may take a week or longer for mortality.
indoxacarb	0.045-0.11	4.6-11.3 oz	7	Apply no more than 11.3 oz per cutting.
lambda-cyhalothrin (Karate Z [2.08EC]) (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	forage harvest: 1 hay harvest: 7	<b>RESTRICTED USE.</b> Apply as required by scouting. <b>Ground application:</b> use 10 to 20 gal water/A. <b>Aerial application:</b> use 2 to 10 gal water/A. Apply in sufficient water for full coverage. Do not apply >0.12 pt/A/cutting. Do not apply >0.48 pt/A/season.
malathion (Malathion 5EC, Malathion 57EC)	1.0-1.5 lb	1.5-2.0 pt	0	Spray may be applied by air or ground equipment. <b>Dilute application:</b> use 20 to 60 gal water/A. <b>Concentrate application:</b> use ≥5 gal water/A.
zeta-cypermethrin (Mustang Maxx)	0.017-0.025 lb	2.8-4.0 oz	cutting/grazing: 3 seed harvest: 7	<b>RESTRICTED USE.</b> Minimum 7 days between applications. Maximum 0.025 lb AI/cutting. Maximum 0.075 lb AI/season.

## Armyworm, Cutworm

Armyworms can be problematic in late summer and early fall. Armyworms are difficult to control with insecticides and options listed below may not effectively reduce large populations of fall armyworm in the fall.

**Table 4.4 - Armyworm (AW), Cutworm (CW)**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	AW 0.0125-0.022 lb CW 0.0065-0.0125 lb	1.6-2.8 oz 0.8-1.6 oz	hay harvest: 7 grazing: 7	<b>RESTRICTED USE.</b> Maximum product allowed per cutting is 5.6 oz/A. Maximum product allowed per crop season is 22.4 oz/A. Effective against small armyworm larvae up to 2nd instar.
carbaryl (Sevin 80 Solpak) (Sevin 4F)	1.0-1.5 lb 1.0-1.5 lb	1.25-1.875 lb 1.0-1.5 qt	hay harvest: 7 grazing: 7	Apply when insects begin to cause injury. A 5% Sevin bait at 20 lb/A also is effective against cutworms.
chlorantraniliprole (Prevathon)	0.047-0.067 lb	14-20 oz	0	Reentry is 4 hours. No more than 60 fl oz or 0.2 lb ai products per year.
lambda-cyhalothrin (Karate Z [2.08EC]) (Warrior II [2.08EC]) armyworm use: cutworm use:	0.02-0.03 lb 0.015-0.025 lb	1.28-1.92 oz 0.96-1.60 oz	forage harvest: 1 hay harvest: 7	<b>RESTRICTED USE.</b> Apply as required by scouting. <b>Ground application:</b> use 10 to 20 gal water/A. <b>Aerial application:</b> use 2 to 10 gal water/A. Apply in sufficient water for full coverage. Do not apply >0.12 pt/A/cutting. Do not apply >0.48 pt/A/season.
malathion (Malathion 5EC) only armyworm	1-1.5 lb	2 pt	0	Spray may be applied by air or ground equipment. <b>Dilute application:</b> use 20 to 60 gal water/A. <b>Concentrate application:</b> use ≥5 gal water/A.
methomyl (Lannate LV) (Lannate SP)	0.225-0.9 lb 0.225-0.9 lb	AW 1.5-3.0 pt CW 0.75-3.0 lb AW 0.5-1.0 pt CW 0.25-2.0 pt	hay harvest: 7 grazing: 7	<b>RESTRICTED USE.</b> Do not apply to dormant or semi-dormant alfalfa when minimum daily temp. is ≤50°F. Wait 7 days after application before grazing or feeding livestock.
zeta-cypermethrin (Mustang Maxx)	0.014-0.025 lb	AW 2.8-4.0 oz CW 2.24-4.0 oz	cutting/grazing: 3 seed harvest: 7	<b>RESTRICTED USE.</b> Minimum 7 days between applications. Maximum 0.025 lb AI/cutting. Maximum 0.075 lb AI/season.

## Pea Aphid

### Sampling/Decision Making

The need to treat for pea aphids is rare (1 year in 10) in Virginia, Maryland, and Delaware because lady bird beetles, wasp parasites, and other beneficial insects usually control this pest. The best sampling technique requires the same 15-inch sweep net used for potato leafhoppers. Ten sweeps at 10 random locations should be used to sample both the aphids and beneficials. If 50 or more aphids per sweep are collected and no beneficials are present, it is recommended that the field be cut early. Avoid spraying first crop because sprays will kill alfalfa weevil parasites.

**Table 4.5 - Recommended Insecticides for Controlling Pea Aphids**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.022 lb	2.8 oz	hay harvest: 7 grazing: 7	<b>RESTRICTED USE.</b> Maximum product allowed per cutting is 5.6 oz/A. Maximum product allowed per crop season is 22.4 oz/A.
dimethoate (Dimethoate 4EC)	0.25-0.5 lb	0.5-1.0 pt	hay harvest: 10 grazing: 10	Make only one application/ cutting.
malathion (Malathion 5EC) (Malathion 57EC)	1.0-1.5 lb	1.5-2.0 pt	0	<b>RESTRICTED USE.</b> Warm weather favors parasites and predators of aphids; thus control may not be required if the weather forecast predicts a warm trend. Spray may be applied by air or ground equipment. <b>Dilute application:</b> use 20 to 60 gal water/A. <b>Concentrate application:</b> use $\geq$ 5 gal water/A.
lambda-cyhalothrin (KarateZ [2.08EC]) (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	forage harvest: 1 hay harvest: 7	<b>RESTRICTED USE.</b> Apply as required by scouting. <b>Ground application:</b> use 10 to 20 gal water/A. <b>Aerial application:</b> use 2 to 10 gal water/A. Apply in sufficient water for full coverage. Do not apply $>$ 0.12 pt/A/cutting. Do not apply $>$ 0.48 pt/A/season.
methomyl (Lannate LV) (Lannate SP)	0.45 - 0.9 lb	1.5-3.0 pt 0.5-1.0 pt	hay harvest: 7 grazing: 7	<b>RESTRICTED USE.</b> Do not apply to dormant or semi- dormant alfalfa when minimum daily temp. is $\leq$ 50°F. Wait 7 days after application before grazing or feeding livestock.
zeta-cypermethrin (Mustang Maxx)	0.014-0.025 lb	2.24-4.0 oz	cutting/grazing: 3 seed harvest: 7	<b>RESTRICTED USE.</b> Minimum 7 days between applications. Maximum 0.025 lb AI/cutting. Maximum 0.075 lb AI/season.

## Orchardgrass, Timothy, and Bermudagrass

*Kathryn Payne, Applied Forage Systems Specialist*

The **immature stage** of white grubs (i.e., Japanese beetle grubs and other related species) and billbug grubs (i.e., bluegrass billbug, hunting billbug) are the most important root-feeding pests on orchardgrass hay in Virginia. Karate Z and Warrior II include these insects on their labels, but only for suppression of adult white grubs and billbugs. The products listed below target surface feeders and insects found in the thatch layer.

**Billbugs:** The conspicuous “paired” feeding-holes seen on young orchardgrass leaves near field borders in late April-early May indicate the presence of billbugs moving into fields. A degree-day (DD) model for bluegrass (and hunting) billbug that accumulates degree days starting March 01 gives a good estimate of when adult billbugs will most likely appear. The DD window for targeting adult billbugs is 280-352 DDs. This DD threshold indicates when it is time to observe along field edges for paired-feeding holes. There is no research-based action threshold for paired-feeding holes, but if holes are observed along field edges or elsewhere in the field you may want to consider using an appropriate insecticide labeled for orchardgrass. The table and map below present DD information for the years 2014-2019, collected from weather stations located in the counties where most of the orchardgrass in Virginia is grown. The table indicates average, earliest, and latest dates reaching 280 DD; and the map shows date ranges for Virginia counties reaching 280 Degree Days.

**Table 4.6 - Average, earliest, and latest date reaching 280 Degree Days, 2014-2019, starting March 01 each year**

County	Station	Location	Average Date Reaching 280 DD	Earliest Date Reaching 280 DD	Latest Date Reaching 280 DD
Pittsylvania	KDAN	Danville Reg. Airport	20-Apr	7-Apr	4-May
Botetourt	C5112	Buchanan	23-Apr	16-Apr	4-May
Franklin	C6097	Moneta	23-Apr	16-Apr	5-May
Rockbridge	GLNV2	GLENPED	24-Apr	15-Apr	5-May
Bedford	AT859	N4GGC Montvale	24-Apr	16-Apr	5-May
Campbell	K0V4	Brookneal (County Airport)	24-Apr	15-Apr	9-May
Albemarle	KCHO	Charlottesville-Alb. Airport	25-Apr	15-Apr	4-May
Culpeper	KCJR	Culpeper Co. Airport	28-Apr	19-Apr	8-May
Fauquier	KHWY	Warrenton-Fauquier	29-Apr	20-Apr	8-May
Loudoun	KJYO	Leesburg / Godfrey	29-Apr	19-Apr	9-May
Orange	KOMH	Orange Co. Airport	30-Apr	21-Apr	10-May
Rockingham	D7567	Elkton	3-May	26-Apr	12-May
Shenandoah	FVRV2	FORT VALLEY	4-May	27-Apr	11-May
Frederick	D8166	Winchester	4-May	26-Apr	10-May
Smyth	KMKJ	Marion / Wytheville	4-May	27-Apr	13-May
Montgomery	KBCB	Va. Tech Airport	4-May	27-Apr	12-May
Augusta	KSHD	Frank's Mill (Staunton)	5-May	25-Apr	13-May
Wythe	SFRV2	STONY FORK	6-May	29-Apr	14-May

#### 4-14 Insect Control in Field Crops: Orchardgrass, Timothy, and Bermudagrass

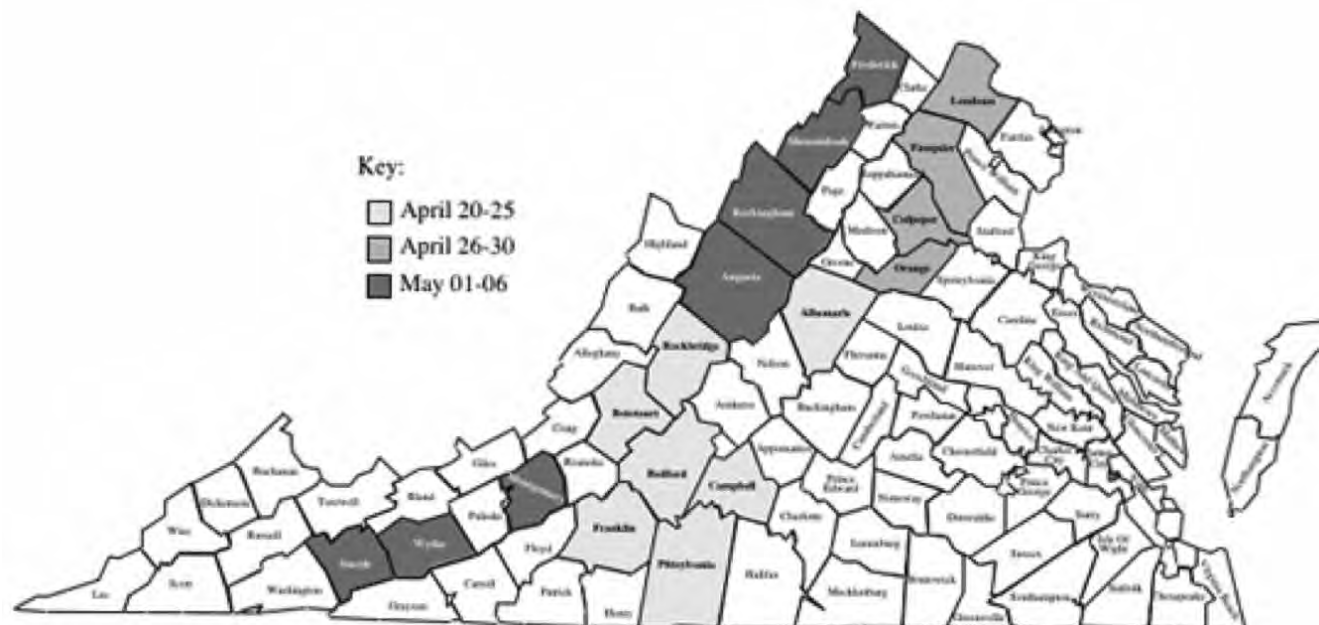


Fig. 4.4. Date range for Virginia counties reaching 280 Degree Days, 2014-2019, starting March 01 each year (Degree days not calculated in unshaded counties).

**Table 4.7 - Orchardgrass, Timothy, Bermudagrass Hay**

Pests	Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
armyworms, cutworms, army cutworm, cereal leaf beetle, green cloverworm, meadow spittlebug	beta-cyfluthrin (Baythroid XL)	0.013-0.015 lb	1.6-1.9 oz	grass for pasture, rangeland and seed: 0 grazing	<b>RESTRICTED USE.</b> For grass grown for hay, pasture, seed, or rangeland, the maximum Baythroid XL allowed per 5-day interval is 0.022 lb A/A (2.8 oz/A). The maximum Baythroid XL allowed per crop season or cutting is 0.089 lb A/A (11.3 oz/A)
fall armyworm (1st & 2nd instar) yellowstriped armyworm (1st & 2nd instar) Lygus bug, stink bugs, leafhoppers, Japanese beetle (adult), June beetle (adult), grasshoppers, grass thrips, tarnished plant bug (refer to label for additional pests)	beta-cyfluthrin (Baythroid XL)	0.02-0.022 lb	2.6-2.8 oz	grass for hay: 0 harvest  grass in mixed stands with alfalfa: 7 harvest 7 grazing	For grass in mixed stands with alfalfa, the maximum Baythroid XL allowed per cutting is 0.022 lb A/A (2.8 oz/A). The maximum Baythroid XL allowed per crop season is 0.089 lb A/A (11.3 oz/A). Check label for additional details.

**Table 4.7 - Orchardgrass, Timothy, Bermudagrass Hay (cont.)**

<b>Pests</b>	<b>Insecticide (Formulation)</b>	<b>Amount active ingredient per acre</b>	<b>Amount product per acre</b>	<b>Time limits: days before harvest</b>	<b>Remarks</b>
armyworm, fall armyworm, striped grass looper, chinch bugs, thrips, range caterpillar, range crane fly, essex skipper, ticks	carbaryl (Sevin XLR Plus and Sevin SL)	1.0-1.5 lb	1.0-1.5 qt	14 harvest or grazing	<b>Caution.</b> Apply as needed by scouting. Up to 2 applications per year may be made but not more often than once every 14 days. Do not exceed a total of 3 qts/A/year.
	carbaryl (Sevin 80 Solupak)	1.0-1.5 lb	1.25- 1.875 lb	14 harvest or grazing	<b>Caution.</b> Up to 2 applications per year may be made but not more often than once every 14 days. Do not exceed a total of 3.75 lbs product/A/year.
army cutworm, cutworms, Essex skipper, range caterpillar, striped grasslooper	lambda- cyhalothrin (Karate Z [2.08EC]) (Warrior II [2.08EC])	0.015- 0.025 lb	0.96-1.6 oz	0 grazing 0 cut for forage 7 harvest after last application	<b>RESTRICTED USE.</b> Apply as required by scouting. Timing and frequency of applications should be based on locally determined economic thresholds. Use sufficient water for full coverage. Use ≥2 gal by air and ≥7 gal by ground.
	chlorantranili- prole + lambda- cyhalothrin (Beseige)		5.0 to 8.0 oz.	See label for grazing and PHI 0 grazing 7 days hay	Maximum of 9 fl. oz per cutting and 27 fl. oz per year.
billbug species (suppression only), beet armyworm, blue stem midge, cereal leaf beetle, chinch bug, crickets, true armyworm, yellowstriped armyworm, fall armyworm, English grain aphid, bird cherry-oat aphid, Russian wheat aphid, sugarcane aphid, greenbug [aphid] (for aphid species best control is obtained before insects begin to roll leaves), flea beetles, leafhoppers, spittlebugs, stink bugs, thrips, grasshoppers, green June beetle (adult), Japanese beetle (adult), webworms	lambda- cyhalothrin (Karate Z [2.08EC]) (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz		Do not apply >0.03 lb AI (1.92 oz product)/A/cutting for pastures, rangeland, and grass grown for seed. A minimum retreatment interval of 30 days is required for pastures and rangeland receiving 0.03 lb AI/A which have not been cut between applications. Do not apply >0.09 lb AI (5.76 oz product)/A/season. Check label for further details.
	chlorantranili- prole + lambda- cyhalothrin (Beseige)		6.0 to 10.0 oz	See label for grazing and PHI 0 grazing 7 days hay	Maximum of 9 fl. oz per cutting and 27 fl. oz per year.

4-16 *Insect Control in Field Crops: Orchardgrass, Timothy, and Bermudagrass*

**Table 4.7 - Orchardgrass, Timothy, Bermudagrass Hay (cont.)**

<b>Pests</b>	<b>Insecticide (Formulation)</b>	<b>Amount active ingredient per acre</b>	<b>Amount product per acre</b>	<b>Time limits: days before harvest</b>	<b>Remarks</b>
armyworms, aphids, cereal leaf beetle, grasshoppers, leafhoppers	malathion (Malathion 5EC)	0.92 lb	1.4 pt	0 harvest or grazing	<b>Warning.</b> REI = 12 hours. Maximum 1 application per cutting
cutworms, flea beetles, meadow spittlebug, potato leafhopper, webworms, blue alfalfa aphid, green peach aphid (Refer to label for additional pests.)	zeta-cypermethrin (Mustang Max)	0.014-0.025 lb	2.24-4.0 oz	0 forage or hay	<b>RESTRICTED USE.</b> Apply minimum 2 gal/A by air or 10 gal/A by ground. Use sufficient water to ensure thorough coverage of foliage. Applications $\geq 7$ days apart for hay and forage. Maximum of 0.025 lb AI/A/cutting. Maximum 0.10 lb AI/A/season.
armyworms, cereal leaf beetle, grasshoppers, plant bugs (including <i>Lygus</i> spp. and stinkbugs) (Refer to label for additional pests.)	zeta-cypermethrin (Mustang Maxx)	0.0175-0.025 lb	2.8-4.0 oz	0 forage or hay	<b>RESTRICTED USE.</b> Apply minimum 2 gal/A by air or 10 gal/A by ground. Use sufficient water to ensure thorough coverage of foliage. Applications $\geq 7$ days apart for hay and forage. Maximum of 0.025 lb AI/A/cutting and Maximum 0.10 lb AI/A/season.



**Table 4.8 - Bermudagrass Pasture**

<b>Pests</b>	<b>Insecticide (Formulation)</b>	<b>Amount active ingredient per acre</b>	<b>Amount product per acre</b>	<b>Time limits: days before harvest</b>	<b>Remarks</b>
fall armyworm, armyworm, striped grass looper	methomyl (Lannate LV)	3.6-14.4 oz	0.75-3.0 pt	7 grazing 3 cutting for hay	<b>RESTRICTED USE. (Danger Poison)</b> 48 hour restricted entry interval. Refer to label for proper handling and application instructions. Do not apply more than 3 pt product/A/crop. Do not make more than 4 applications/crop.
Bermudagrass stem maggot	zeta cypermethrin (Mustang Maxx)	0.0175-0.025 lb	2.8-4.0 oz	0 days grazing and hay harvest	<b>RESTRICTED USE.</b> No more than 20 fl oz/A of product per year. Apply after cutting and as grass starts to resprout. Only controls the adult flies, does not control the larvae feeding inside the stem.



## Corn

*Sean Malone, Research Associate, Virginia Tech*  
*Arash Rashed, Associate Professor, Virginia Tech*  
*Sally Taylor, Agricultural Research Director, Cotton Inc.*

All commercial corn seed is sold with insecticide applied by the manufacturer. Insecticides target below-ground or early-season pests (seedcorn maggot, wireworms, white grubs, corn rootworms, corn root aphid). Different companies use different trade names for their seed treatments. Please refer to the publication “What’s on your seed?” produced by the University of Wisconsin-Madison to determine which product(s) are applied to your seed. Link to publication - [https://ipcm.wisc.edu/wp-content/uploads/sites/54/2022/11/Whats\\_on\\_your\\_seed\\_web.pdf](https://ipcm.wisc.edu/wp-content/uploads/sites/54/2022/11/Whats_on_your_seed_web.pdf). Although purchasing an insecticide is not optional, higher rates may be ordered. Unless a field has a history of high pest pressure, additional or higher rates are not recommended.

### Seedcorn Maggot

#### Seedcorn Maggot Sampling/Decision Making

All commercial corn seed is sold with insecticide applied to the seed coating that control seed corn maggot. The window of protection offered may not overlap with pest pressure and the rate of active ingredient in the plant declines rapidly three weeks post-planting. Seed treatments are less effective in hot/dry and wet/cool conditions when plant growth is slow and uptake is not ideal. Old sod fields, pasture, heavily manured fields and fields with previous histories of seedcorn maggot damage may require a higher rate of insecticide regardless of planting time or type of tillage. Seedcorn maggot cannot be effectively managed after corn is planted. Insecticides labeled are to be applied on the seed coating or in-furrow during planting.

**Table 4.9 - Recommended Pesticides for Controlling Seedcorn Maggot**

Insecticide (Formulation)	Amount active ingredient	Amount product	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.022 lb AI/A (based on 30-inch row spacing)	0.12-0.16 oz/1,000 row ft 2.0-2.8 oz/A	grain or fodder: 21 Green forages after last application: 0	<b>RESTRICTED USE.</b> Maximum product allowed at planting: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Row width adjustment: for row spacing <30 inches, adjust rate of product not to exceed 2.8 oz/A. Note: Diminished control may occur when rates are decreased below recommended minimum rates per 1,000 row ft.
bifenthrin (Capture LFR)	0.04-0.2 lb AI/A	3.4-17 oz/A 0.2-0.98 oz/1000 row ft	—	Apply 5- to 7-inch band (T-band) over open furrow or in-furrow with the seed. Maximum 0.2 lb ai/A/season as an at-plant application. Maximum 0.3 lb ai/A/season of at-plant plus foliar applications of other bifenthrin products.
clothianidin (Poncho 600)	0.25-0.50 mg AI/kernel	1.13-2.26 oz/80,000 seeds	—	Product is usually applied by manufacturer to seed upon request of grower at the time seed is ordered. Avoid breathing dust and contact with skin and eyes.
thiamethoxam (Cruiser 5FS)	0.25-0.80 mg AI/kernel	1.13-3.62 oz/80,000 seeds	—	Product is usually applied by manufacturer to seed upon request of grower at the time seed is ordered. Avoid breathing dust and contact with skin and eyes.

## Wireworms

### Wireworm Sampling/Decision Making

First-year corn following established sod is frequently attacked by wireworms. Continuous corn and small grain are also at high risk. Bait stations can be used to determine high-risk fields. Two paired bait stations per acre are made by placing 0.5 cup of an equal mixture of untreated corn/wheat (flour may also be used) in the soil 4 inches deep and covered with dark plastic. Set bait stations in fields to be planted at least 3 weeks before the planting date. Check by digging in about 2 weeks and record the number of wireworms for each station. Economic thresholds for wireworms have not been established on corn; however, if an average of 1 or more wireworms per bait station are found, a soil insecticide or a higher rate of seed treatment should be applied. Wireworms cannot be effectively managed after corn is planted. Insecticides labeled are to be applied on the seed coating or in-furrow during planting. Rates can be found on the bag label. It is also important to note that wireworms are a complex of several species, and knowing the species infesting the field can help predict the time of activity and damage.

**Table 4.10 - Recommended at Planting Pesticides for Controlling Wireworms**

Insecticide (Formulation)	Amount active ingredient per 1,000 row ft	Amount product per 1,000 row ft	Time limits: days before harvest	Remarks
bifenthrin (Capture LFR)	0.04-0.2 lb/AI/A	3.4-17 oz/A 0.2-0.98 oz/ 1000 row ft	—	Apply as an in-furrow spray, microsteam, or 5 to 7 inch T-band. Maximum 0.2 lb ai/A/season as an at-plant application. Maximum 0.3 lb ai/A/season of at-plant plus foliar applications of other bifenthrin products.
clothianidin (Poncho 600)	0.25-0.50 mg AI/kernel	1.13-2.26 oz/80,000 seeds	—	Product is usually applied by manufacturer to seed upon request of grower at the time seed is ordered. Avoid breathing dust and contact with skin and eyes.
phorate (Thimet 20G)	0.9-1.2 oz	4.5-6.0 oz	30	<b>RESTRICTED USE.</b> Apply at planting in a 7-inch band over the row, in front of or behind the presswheel and lightly incorporate. Granules must be incorporated into the soil. <b>Do not apply Thimet in-furrow. In-furrow application can reduce stand.</b>
tefluthrin (Force 3G)	0.12-0.15 oz	4-5 oz	30	<b>RESTRICTED USE.</b> Apply in-furrow at planting for best control. Rotational crops may be planted 30 days after application.
terbufos (Counter 20G SmartBox®)	0.9-1.2 oz	4.5-6.0 oz	30	<b>RESTRICTED USE.</b> Apply at planting in 4-5-inch band over the row, in front of or behind the presswheel and lightly incorporate. Can also be applied in-furrow. <b>If application is made at planting, do not make postemergence or cultivation time treatments of Counter.</b> Use of Accent or Beacon herbicides following Counter applications may result in crop injury.
thiamethoxam (Cruiser 5FS)	0.250-0.80 mg AI/kernel	—	—	Product is usually applied by manufacturer to seed upon request of grower at the time seed is ordered. Avoid breathing dust and contact with skin and eyes.

## White Grubs

### White Grub Sampling/Decision Making

Spring planting into former soybean fields or old sod fields are often at risk for white grubs and, to a lesser extent, wireworms. In most years, white grub species stop feeding to pupate in mid- to late May in Virginia. Late-planted corn and conventional-tilled corn are at lower risk from white grubs.

All commercial corn seed is sold with insecticide applied by the manufacturer. Higher rates are either ordered from the manufacturer at the time the seed order is placed, or may be applied by the dealer. Use higher rates only in high-risk fields. A fall soil sampling method for predicting spring-planted cornfields with economic infestations of white grubs is described below. White grubs cannot be effectively managed after corn is planted. Insecticides labeled are to be applied on the seed coating or in-furrow during planting. Rates can be found on the bag label.

### Compact Method (CM) Soil Sampling Strategy: Fall and spring research-based action thresholds in corn

The CM is a soil sampling strategy for white grubs that provides timely and useful information for pest management decision-making. The CM is based on an 8-inch square by 6-inch deep volume of soil that is hand-sifted for white grubs on a green plastic leaf collection bag placed on the ground next to the sample site. The CM soil sampling strategy was designed for fall sampling as a means to provide producers with a field-specific pest management tool for better managing white grubs on their farms. Using the CM for spring soil sampling of white grubs before planting corn is as useful as fall sampling with the CM. However, keep in mind that sampling in the fall gives you more time to make a decision about white grub management than sampling in the spring.

**Definition of Action Threshold (AT):** Levels of pest populations at which control should be implemented to avoid significant damage to the crop (determined from research-based relationship of pest levels on yields).

**Thresholds:** The fall AT is  $\geq 1.6$  white grubs per CM soil sample. The spring AT is  $\geq 1.04$  white grubs per CM soil sample.

**The following represents the minimum number of compact method samples needed per field to be 95 percent confident your sample average is within the specified percentage of the actual field mean:**

- 25% 3 to 4 samples/field (about 10-15 minutes)
- 20% 5 to 6 samples/field (about 20-25 minutes)
- 15% 10 samples/field (about 30-40 minutes)
- 10% 22 samples/field (about  $\geq 1.5$  hours)

One point of caution, although soil sampling for white grubs works well in most soils: it is easier to hand sift lighter, sandier soils than heavier soils which do not break apart easily. No data is available for muck soils.

**Table 4.11 - Recommended Pesticides for Controlling White Grubs**

Insecticide (Formulation)	Amount active ingredient per 1,000 row ft	Amount product per 1,000 row ft	Time limits: days before harvest	Remarks
bifenthrin (Capture LFR)	0.04-0.2 lb ai/A	3.4-17 oz/A 0.2-0.98 oz/1000 row ft	—	Apply 5- to 7-inch band (T-band) over open furrow or in-furrow with the seed. Maximum 0.2 lb ai/A/season as an at-plant application. Maximum 0.3 lb ai/A/season of at-plant plus foliar applications of other bifenthrin products. Provides control alone without addition of seed treatment.
clothianidin (Poncho 600)	0.25-0.50 mg ai/kernel	1.13-2.26 oz/80,000 seeds	—	Product is usually applied by manufacturer to seed upon request of grower at the time seed is ordered. Avoid breathing dust and contact with skin and eyes. Note: High rate is recommended based on VA research.

**Table 4.11 - Recommended Pesticides for Controlling White Grubs (cont.)**

Insecticide (Formulation)	Amount active ingredient per 1,000 row ft	Amount product per 1,000 row ft	Time limits: days before harvest	Remarks
phorate (Thimet 20G)	0.9-1.2 oz	4.5-6.0 oz	30	<b>RESTRICTED USE.</b> Apply at planting in a 7-inch band over the row, in front of or behind the presswheel and lightly incorporate. Granules must be incorporated into the soil. <b>Do not apply Thimet in-furrow. In-furrow application can reduce stand.</b>
tefluthrin (Force 3G)	0.12-0.15 oz	4.0-5.0 oz	—	<b>RESTRICTED USE.</b> Apply in furrow at planting for best control. Rotational crops may be planted 30 days after application.
terbufos  (Counter 20G SmartBox®)	0.9-1.2 oz	4.5-6.0 oz	30	<b>RESTRICTED USE.</b> Apply at planting in a 4-5-inch band over the row, in front of or behind the presswheel and lightly incorporate. Can also be applied in-furrow. <b>If application is made at planting, do not make postemergence or cultivation time treatments of Counter.</b> Use of Accent or Beacon herbicides following Counter applications may result in crop injury.
thiamethoxam (Cruiser 5FS)	0.25-0.80 mg AI/kernel	1.13-3.62 oz/80,000 seeds	—	Note: High rate (0.5-1.25 mg) is recommended based on VA research.
chlorantraniliprole (Lumivia)	0.25-0.75 mg AI/kernel	1.08-3.25 oz/80,000 seeds	—	

## ***Baited Wire Trap Procedure for Scouting***

### **Seedcorn maggot, wireworms, and white grubs can be scouted before planting**

The wire trap itself consists of a 2-ft long by 3-inch wide strip of 0.25-inch hardware cloth (see image below). To strengthen the hardware cloth strip and to facilitate the placement of the corn seed bait, the strip should be bent lengthwise at a 90° angle. Use only corn seeds that have **not been treated** with an insecticidal seed treatment for bait, such as deer corn. About 2 weeks before planting, place 20 seeds about 1 inch apart in each wire trap and then bury the baited wire trap 2 inches deep in the soil. Install at least 1 baited wire trap for every acre of corn to be planted. Remove the traps from the soil after 2 weeks and determine the average number of seeds with feeding damage in the wire traps. The following suggested guidelines may help you determine whether your field is at risk to wireworms, seedcorn maggots, or white grubs.

## ***Suggested Treatment Guidelines Using the Baited Wire Trap Method***

### **Conditions for using the baited wire trap method for field corn**

1. Unless continuous corn fields have already been scouted for corn rootworms, baited wire traps should only be used in fields in which corn typically is grown in rotation with soybeans, alfalfa, sorghum, or peanuts (see exceptions below for explanation).
2. Refer to the following suggested treatment guidelines for seedcorn maggots, wireworms, and annual white grubs to determine if a granular insecticide may be needed at planting to prevent serious stand loss.

### Seedcorn maggot

A granular insecticide or a higher rate of seed treatment may be needed at planting if the average number of seeds damaged by seedcorn maggots in the baited wire traps is **25 percent** or more; otherwise, an insecticidal seed treatment should be sufficient.

### Wireworms

A granular insecticide or a higher rate of seed treatment may be needed at planting if the average number of seeds damaged by wireworms in the baited wire traps is **10 percent** or more; otherwise, an insecticidal seed treatment should be sufficient.

### Annual white grubs (i.e., grubs with a 1-year life cycle: Japanese beetle, green June beetle, etc.):

A granular insecticide or a higher rate of seed treatment may be needed at planting if the average number of seeds damaged by annual white grubs in the baited wire traps is **5 percent** or more.

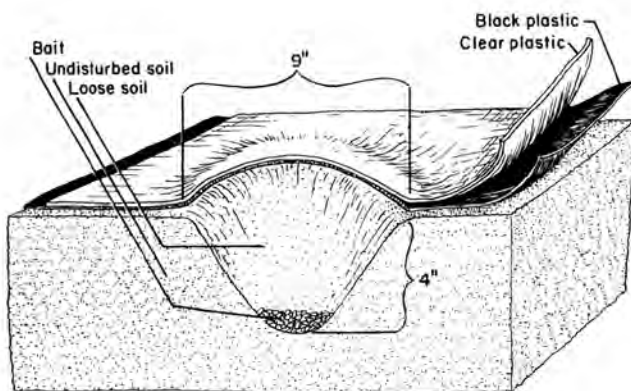
### Default

If you are unable to discern which pest is responsible for damaging the corn seeds in the baited wire traps, and if the average number of seeds damaged in the baited wire traps is **5 percent** or more, then a granular insecticide or a higher rate of seed treatment may be needed at planting to prevent serious stand loss.

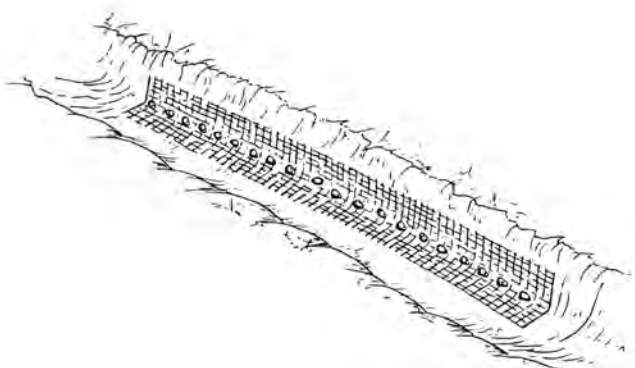
### Exceptions

Cropping situations in which the producer is encouraged to make an in-furrow, T-band, or banded over-the-row application of a granular insecticide or a higher rate of seed treatment when planting field corn (**and not just rely on the base rate of insecticidal seed treatment**) are the following:

- a. when planting corn in old sod or pasture fields, because severe damage from wireworms may occur. Less frequently, damage may occur from true white grubs (i.e., *Phyllophaga* spp. with 2- to 3-year life cycles).
- b. when a field is in continuous corn production, because of the potential for corn rootworm damage, and because the low rate of seed treatments do not control corn rootworms. High rates (e.g., clothianidin applied at the rate of 1.25 mg a.i./seed) provide similar protection against corn rootworm as Bt traits. Soil treatments are not recommended if using a high rate on the seed or two-gene Bt trait hybrids.



*Fig. 4.5a Bait Station (Cross Section)*



*Fig. 4.5b Baited Wire Trap*

## Corn Root Aphid

Corn root aphids are a sporadic pest of field corn in Virginia. Currently, only organic corn is at risk from this pest. Planting field corn no-till in fields with a history of corn root aphid problems can lead to serious root injury if a proper soil insecticide has not been applied at planting. Corn root aphids injure corn by piercing the roots with their stylet-like mouthparts and extracting the sap. The growth of infested corn plants often is stunted and, under severe infestations, may be arrested at a height of only 10 inches.

The ability of this aphid to infest corn roots is highly dependent upon certain species of ants commonly known as corn field ants. Shortly after germination, the ants begin carrying the aphids to the developing corn roots. Aphid numbers increase rapidly once in contact with the roots; females are capable of producing 40 to 50 live nymphs each, and generations can be as short as eight days during warm growing conditions. The ants benefit from this relationship by harvesting the droplets of honeydew produced by the aphids while feeding on the roots.

To determine if a field is at risk to corn root aphids, no-till fields should be scouted for the presence of anthills before planting because, unlike conventionally tilled fields, no-till fields are more likely to have established ant colonies. It should be kept in mind, however, that it is possible for a field to have anthills present without the presence of corn root aphids. Although no specific label reference to corn root aphids has been found among the list of insecticides currently available for use on field corn, application of a granular insecticide at planting to control wireworms or corn rootworms may alleviate a corn root aphid problem. In addition, two cultural practices which can play a role in minimizing corn root aphid infestations are deep tillage every other year to weaken ant colonies, and crop rotation to prevent the buildup of large ant and aphid populations.

## Billbug

The southern corn billbug and maize billbug are known to occur throughout the coastal plain of North Carolina and in the Tidewater region of southeastern Virginia. Unlike other areas of Virginia, the relatively higher organic matter content and poorer drainage characteristics of the soils in southeastern Virginia are two factors considered favorable to billbug infestations. In 2017-2019, billbug damage was identified in some northern coastal Virginia no-till fields. Scouting is recommended in all Eastern fields with high organic matter content and/or that are poorly drained.

Both adult and immature stages of billbugs damage corn seedlings. Adult billbugs chew into the side of corn seedlings and feed on the inner plant tissue. Eggs are deposited by females within the feeding cavity and hatch in 4 to 15 days. The legless larvae feed in and around the taproot for several weeks. There is only one generation per year. Damaged seedlings which survive infestation typically are stunted, or otherwise deformed, and may exhibit excessive suckering and rows of transverse holes on the leaves.

Rotation is considered the least expensive and most effective method of controlling billbug infestations provided that corn is rotated about 0.25 mile from its previous location. When rotation is not possible, higher rates of neonicotinoid seed treatments (e.g., Poncho 1250) are recommended. Scouting this season will help you make informed decisions in the following year. Billbugs cannot be effectively managed after corn is planted. Insecticides labeled are to be applied on the seed coating or in-furrow during planting. Rates can be found on the bag label.

**Table 4.12 - Preemergence Use of Insecticides to Control Billbugs**

**Note:** Continuous corn, corn planted near last year's corn, corn planted mid-April, and corn near good overwintering habitats are at high risk. These products may not provide adequate control in these situations.

Insecticide (Formulation)	Amount active ingredient per 1,000 row ft	Amount product per 1,000 row ft	Time limits: days before harvest	Remarks
clothianidin (Poncho 1250)	1.25 mg AI/ kernel	5.64 oz/80,000 seeds	—	Product is usually applied by manufacturer to seed upon request of grower at the time seed is ordered. Avoid breathing dust and contact with skin.
thiamethoxam (Cruiser 5FS)	1.25 mg AI/ kernel	5.64 oz/80,000 seeds	—	Product is usually applied by manufacturer to seed upon request of grower at the time seed is ordered. Avoid breathing dust and contact with skin.



## Cutworm

### **Cutworm Sampling/Decision Making**

Late-planted, minimum-till fields with heavy spring weed growth on poorly drained soils are the most likely to encounter cutworms. Corn fields should be checked twice a week from the spike through the 5th-leaf stage. Leaf feeding is the first sign that cutworms are present. Look for small, irregular holes in leaves and cut plants. Note any leaf feeding that may have resulted from cutworms too small to cut plants and check these areas again in 24 to 48 hours. If cutworms are present, examine at least 10 sets of 20 plants throughout the field and record the percentage of cut or damaged plants. At the same time, look under clods and dig 1 to 2 inches deep around the bases of damaged plants to find cutworms. Record the average size and number of cutworms. Most armyworm and cutworms species are active at night and hide under plant residue and soil surface, mud cracks and/or soil clods. Therefore, their presence may go undetected until damage symptoms appear.

As a general guideline, before the 3rd- to 5th-leaf stage, a rescue treatment should be applied if 10% or more of the young plants show fresh leaf feeding and cutworms are present. At the 3rd- to 5th-leaf stage, treatment should be applied if 5% of the plants are cut and there are 4 or more cutworms per 100 plants.

Most commercial Bt corn hybrids express Bt toxins to control cutworm feeding. Plant refuges as required by label instructions. Applying an insecticide with herbicide pre-plant or at-plant has been demonstrated to increase risk from slug feeding. This practice should only be considered in fields with significant history of cutworms.

**Table 4.13 - Recommended Postemergence Insecticides to Control Cutworms**

<b>Insecticide (Formulation)</b>	<b>Amount active ingredient per acre</b>	<b>Amount product per acre</b>	<b>Time limits: days before harvest</b>	<b>Remarks</b>
beta-cyfluthrin (Baythroid XL)	0.007-0.022 lb	0.8-2.8 oz	grain or fodder: 21 Green forages after last application: 0	<b>RESTRICTED USE.</b> Rate depends on cutworm species. Maximum product per 7-day interval: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Maximum number of applications per season: 4.
bifenthrin (Brigade, others) 2 EC	0.033-0.10 lb	2.1-6.4 oz	—	<b>RESTRICTED USE.</b> Use at least 10 GPA by ground. Use high rates for heavy infestations and aerial applications.
bifenthrin zeta-cypermethrin (Hero 1.24 EC)	0.025-0.06 lb	2.6-6.1 oz	30 grain and stover, 60 forage	<b>RESTRICTED USE.</b> Use at least 10 GPA by ground. Use high rates for heavy infestations and aerial applications. Do not apply more than 0.4 lb AI/A/season for foliar applications. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply if heavy rainfall is imminent.
esfenvalerate (Asana XL)	0.03-0.05 lb	5.8-9.6 oz	21	<b>RESTRICTED USE.</b> Use sufficient water to ensure thorough coverage of treated plants.
lambda-cyhalothrin (Warrior II [2.08EC])	0.015-0.025 lb	0.96-1.60 oz	21	<b>RESTRICTED USE.</b> Apply as required by scouting, usually at intervals of 7 or more days. Apply by ground or air using sufficient water for full coverage. <b>Aerial application:</b> use ≥2 gal water/A. Do not apply >0.48 pt/A/season. Do not apply >0.24 pt/A after silk initiation. Do not apply >0.12 pt/A after milk stage.
methoxyfenozide (Intrepid 2F)	0.06-0.25 lb	4-16 oz	21	Western bean cutworm.
zeta-cypermethrin (Mustang Maxx)	0.008-0.0175 lb	1.28-2.8 oz	7 grain, stover, and forage	<b>RESTRICTED USE.</b> Use minimum 10 gal water/A.

## Armyworm

### Fall Armyworm

Late planted fields are at risk of economic infestations. Fall armyworm does not overwinter in Virginia. Control is recommended for leaf feeding if larvae are present on >50% of plants. Larvae may infest ears if crop matures late. Most commercial Bt corn hybrids express Bt toxins to control fall armyworm feeding. Please note that hybrids containing only Cry1F are not recommended for fall armyworm control in Virginia. Plant refuges as required by label instructions.

### True Armyworm Sampling/Decision Making

Armyworm is not commonly an economic pest, but economically damaging infestations can occasionally occur in seedling and whorl stage corn. No-till fields planted into a small grain cover crop, pastures, or weedy fields all have at higher risk for armyworm infestation. Survey field edges where margins border small grains or large grassy areas and watch for damaged plants. If armyworm damage is seen, examine 20 plants at each of 5 locations within the field and record the percentage of damaged plants, the average size, and the severity of injury.

Armyworms usually migrate from small grains starting in late May. Controlling grassy weeds will help prevent infestations. Spot treatments may be warranted if infestations are confined to small areas. Control for armyworms is recommended if 35 percent or more of the plants are infested and 50 percent or more defoliation is seen on the damaged plants, provided that larvae average less than 0.75 inch long. Worms greater than 1.25 inches in length usually have completed their feeding. Soil applied insecticides are not effective against this pest. Transgenic corn varieties control armyworm. Plant refuges as required by label instructions.

Research at Virginia Tech has shown that rotary mowing of the rye cover crop after it has initiated seed heads will not only kill the cover crop, but also will dramatically reduce the number of armyworm larvae early in the growing season when the corn is susceptible to damage from armyworm feeding. If mowing is to be used to kill the winter cover crop, corn planting should follow as soon as possible after mowing to facilitate coulters penetration of the rye mulch.

**Table 4.14 - Recommended Postemergence Insecticides to Control Fall Armyworm**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
chlorantraniliprole (Prevathon 0.43 SC)	0.047-0.067	14-20	14 for ears	Use a minimum of 15 GPA for whorl treatment. Less effective against large larvae.

**Table 4.15 - Recommended Postemergence Insecticides to Control True Armyworm**

<b>Insecticide (Formulation)</b>	<b>Amount active ingredient per acre</b>	<b>Amount product per acre</b>	<b>Time limits: days before harvest</b>	<b>Remarks</b>
beta-cyfluthrin (Baythroid XL)	0.0125-0.022 lb	1.6-2.8 oz	grain or fodder: 21 Green forages after last application: 0	<b>RESTRICTED USE.</b> Effective against 1st and 2nd instars only. Maximum product per 7-day interval: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Maximum number of applications per season: 4.
bifenthrin (Brigade, others)	0.033-0.10 lb	2.1-6.4 oz	—	<b>RESTRICTED USE.</b>
bifenthrin zeta-cypermethrin (Hero [1.24 lb AI/gal prod])	0.04-0.1 lb	4.0-10.3 oz	30 grain and stover, 60 forage	<b>RESTRICTED USE.</b> For grain, silage, and seed use. Do not apply more than 0.4 lb AI/A/season for foliar applications. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply if heavy rainfall is imminent.
chlorantraniliprole (Prevathon 0.43 SC)	0.047-0.067 lb	14-20 oz	14 for ears	May not effectively control large larvae.
esfenvalerate (Asana XL)	0.03-0.05 lb	5.8-9.6 oz	21	<b>RESTRICTED USE.</b> Use sufficient water to ensure thorough coverage of treated plants.
lambda-cyhalothrin (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	21	<b>RESTRICTED USE.</b> For control of small larvae only. Apply as required by scouting, usually at intervals of 7 or more days. Apply by ground or air using sufficient water for full coverage. <b>Aerial application:</b> use $\geq 2$ gal water/ A. Do not apply $>0.48$ pt/A/season. Do not apply $>0.24$ pt/A after silk initiation. Do not apply $>0.12$ /A pt after milk stage.
methomyl (Lannate LV)	0.225-0.45 lb	0.75-1.5 pt	3 forage	<b>RESTRICTED USE.</b>
(Lannate SP)	0.225-0.45 lb	0.25-0.5 lb	21 ears 21 fodder	Apply when insects first appear. Use sufficient water to ensure thorough coverage of treated plants.
spinosad (Blackhawk 4 SC)	0.038-0.075 lb	1.67-3.3 oz	7 forage and seed, 28 grain	May not effectively control large larvae.
zeta-cypermethrin (Mustang Maxx)	0.02-0.025 lb	3.2-4.0 oz	7 grain, stover, and forage	<b>RESTRICTED USE.</b> Use minimum 10 gal water/A.

## Slugs and Snails

### *Slug, Snail Sampling/Decision Making*

Slugs can become serious pests in no-till fields during periods of cool, wet weather. Fields with heavy layers of manure, plant residue, or thick weed cover are at higher risk from slugs. Because slugs feed at night and hide during the day in the mulch and surface trash near the seedlings, they often are not seen on scouting trips. Slugs can be found during the day by turning over clods of dirt and surface trash near the seedlings. Corn seedlings that have reached the 3rd-leaf stage of growth generally are able to outgrow feeding damage by slugs.

## 4-28 Insect Control in Field Crops: Corn

Cultural practices which may help reduce slug populations include reduction in the use of manure, shift to conventional tillage practices for at least one season, and minimum tillage to reduce the amount of surface trash. Slugs are not controlled with insecticides. Because slug predators (e.g., ground beetles, harvestmen, and spiders) are killed by insecticide applications, using insecticides prior to or at the time of planting increases the risk and severity of slug feeding.

**Table 4.16 - Postemergence Use of Insecticides to Control Slugs and Snails**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
iron phosphate (Sluggo)	0.2-0.44 lb	20-44 lb	0	At the seedling and later stages, apply the bait between the rows and around the perimeter of the field. Use higher rates for heavier infestations.
metaldehyde (Deadline M-Ps)	1 lb maximum	25 lb/A maximum	0	Apply as a broadcast or ground directed. Maximum number of applications per season: 3.

## Western Corn Rootworm

There is one generation of western corn rootworm (WCR) (<https://www.pubs.ext.vt.edu/ENTO/ENTO-302/ENTO-302.html>) per year. In late summer, adults lay eggs in soil in cornfields. Eggs overwinter in the soil and hatch the following late spring through summer. Larvae (grubs) immediately search for corn roots on which to feed, and then pupate in the soil. Adults (beetles) emerge from late June through August and fly to corn plants to feed and mate.

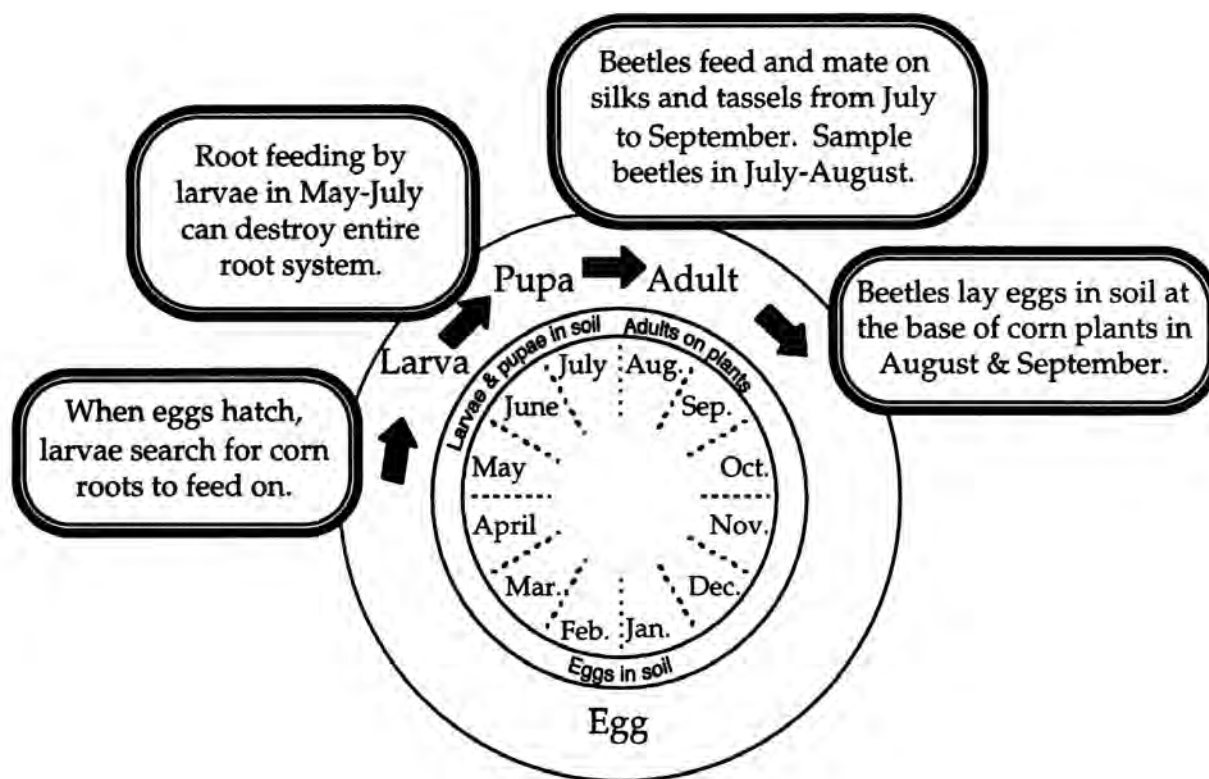


Fig. 4.6 Western corn rootworm life cycle in Virginia

Larvae feed almost exclusively on corn roots, so control is easily accomplished through crop rotation in Virginia. Note that changes in climate and weather patterns can influence the life cycle. However, many farmers do not have the option of rotating out of corn, thus the next best control measures are to plant Bt corn hybrids with rootworm specific traits (Agrisure, Herculex XTRA, Genuity VT Triple Pro, SmartStax), or use a seed treatment. Please note that Bt corn hybrids containing only Cry3 toxins (mCry3A, Cry3Bb1, and eCry3.1Ab) have experienced performance issues in Virginia. No issues have been reported with Bt corn hybrids containing Cry34Ab1/35Ab1. Plant refuges as required by label if transgenic varieties are used. As the life cycle indicates, treatment of first year corn to control WCR is not necessary. Also, rootworm populations in subsequent years of continuous corn may not be large enough to warrant treatment. Economic damage thresholds for rootworm beetles have been developed by correlating beetle populations in a particular field with subsequent larval feeding damage occurring the following year.

## **Sampling**

Western corn rootworm beetles can be sampled in July and August to determine whether a control measure is needed the following year. Two methods for scouting corn rootworm beetles are described here.

### **1. Yellow sticky card method**

Place two-sided 4 x 6-in yellow sticky cards (traps), available through various vendors, in cornfields starting in early July. Use the table below to determine how many traps to install. Place traps about 300 feet apart and at least 100 feet in from all field edges. Place a series of traps along the same corn row. When approaching the field edge, cross over about 30 rows and place another series of traps along a row until the entire field is covered. Use flags to mark the location of each trap. Use continuous flagging (forestry tape) when crossing rows and to mark the start of the trap line. Attach traps to corn plants at a height of about 4 feet. Break off any leaves on the plant and adjacent plants that could possibly stick to a trap. Monitor the traps every 9 to 10 days, recording the number of western corn rootworm beetles on each trap. At each site remove the release paper from the unused side of the trap and re-install the trap on the corn stalk with the fresh side exposed. Install new traps every other visit.

**Table 4.17 - Determining the Number of Traps to Place in a Field**

<b>Field Size (Acres)</b>	<b>Number of Traps per Field</b>
1 to 5	3
6 to 10	6
11 to 15	9
16 to 20	13
21 to 25	16
26 to 30	19
31 to 35	23
36 to 40	26
41 to 45	30
46 to 50	34
51 to 55	37
56 to 60	40

## **Decision Making**

After counting the rootworm beetles on all traps, determine the average number of beetles per trap per week using the following formula:

$$\text{Average beetles per trap per week} = \text{Total Beetles} \div \text{No. of usable traps} \div \text{No. of days since last sampled} \times 7$$

## 4-30 Insect Control in Field Crops: Corn

If a field has 20 or more rootworm beetles per trap per week, that field is above threshold and should be rotated out of corn. Once a field exceeds the threshold there is no need to scout it again this year.

If trap catch never reaches 20 beetles per trap per week, the field is below threshold and no treatment is recommended for rootworm control the following year. Scouting can be discontinued if trap counts decline for three consecutive sampling periods.

### 2. Ear zone count method

Survey fields 4 or 5 times from the second week in July through the third week in August to estimate the number of western corn rootworm beetles in the field. Count the corn rootworm beetles in the ear zone of 50 corn plants throughout each field. The ear zone is the area from the upper surface of the leaf just below the ear to the lower surface of the leaf just above the ear, and includes the ear and ear leaf. Calculate the average number of beetles per ear zone. When scouting fields that have been in corn more than one year, an average count of 1.0 beetle or more per ear zone indicates that the field should be rotated out of corn. When scouting first year corn, control for rootworms the following year if the average count is 0.75 beetles or more per ear zone, because primarily egg-laying females migrate to new cornfields.

**Table 4.18 - Western Corn Rootworm**

Insecticide (Formulation)	Amount active ingredient per 1,000 row ft	Amount product per 1,000 row ft	Time limits: days before harvest	Remarks
terbufos  (Counter 20G SmartBox®)	0.9-1.2 oz	4.5-6.0 oz	30	<b>RESTRICTED USE.</b> Apply at planting in a 4-5-inch band over the row, in front of or behind the press wheel and lightly incorporate. Can also be applied in-furrow. <b>If application is made at planting, do not make postemergence or cultivation time treatments of Counter.</b> Use of Accent or Beacon herbicides following Counter applications may result in crop injury.
tefluthrin (Force 3G)	0.12-0.15 oz	4.0-5.0 oz	–	<b>RESTRICTED USE.</b> Apply at planting in a 7-inch band over the row, in front of or behind the presswheel and incorporate the granules into the top 1 inch of soil. Can also be applied in-furrow. Rotational crops may be planted 30 days after application. Can also be applied at cultivation within 30 days of seedling emergence (must be soil incorporated). Use only once per crop.
clothianidin (Poncho 1250)	1.25 mg AI/ kernel	5.64 oz/80,000 seeds	–	Product is usually applied by manufacturer to seed upon request of grower at the time seed is ordered. Avoid breathing dust and contact with skin.
thiamethoxam (Cruiser 5FS)	1.25 mg AI/ kernel	5.64 oz/80,000 seeds	–	Product is usually applied by manufacturer to seed upon request of grower at the time seed is ordered. Avoid breathing dust and contact with skin.

**Table 4.19 - Bt Proteins Active Against Western Corn Rootworm**

Protein*	Product	First Marketed
Cry3Bb1	YieldGard	2003
mCry3A	Agrisure	2006
Cry34/35Ab1	Herculex, Optimum	2005
Cry3Bb1 + Cry34/35Ab1	Smartstax	2009
eCry3.1Ab	Duracade	2014

\*Resistance by western corn rootworm (WCR) to Bt hybrids expressing either the Cry3 or mCry3A protein has been documented in Midwestern cornfields since 2009 and Virginia cornfields since 2016.

In some locations in Virginia corn rootworm Bt hybrids expressing only Cry3 proteins have experienced considerable root damage and lodging from WCR feeding.

**To preserve the efficacy of Bt traits against western corn rootworm:**

**Rotate mode of action** by planting a hybrid with a different Bt trait or multiple Bt traits for rootworm, or plant a conventional hybrid with a seed treatment.

**Rotate** out of corn every 3 to 4 years to break the corn rootworm life cycle.

**Follow refuge compliance:** A refuge (5-20%, depending on hybrid) of non-Bt corn is used to delay the development of resistance to the Bt toxin.

## European Corn Borer (ECB)

All Bt corn hybrids produce toxins that provide control of ECB in Virginia. A population in Nova Scotia, Canada, demonstrated resistance to single-gene Cry1F hybrids in 2018. Best management practices for delaying resistance include planting refuges and, whenever possible, planting hybrids that contain two or more genes for above ground insect control. The following recommendations are for conventional corn only.

### **First Generation**

The potential for first-generation damage in field corn during the whorl stage is impossible to predict prior to planting. The best strategy is to scout each field and apply a whorl application of a granular or liquid insecticide if the ECB infestation exceeds the treatment threshold (see Decision Making below). Historically, not all fields need to be treated with insecticides every year. Furthermore, many corn varieties are able to tolerate moderate levels of leaf and stalk injury without economic yield loss. **Also, corn grown for silage rarely needs to be treated for ECB.**

The decision to treat a first generation ECB infestation should be based on the following two criteria: (1) the number of plants exhibiting fresh whorl feeding damage, and (2) the presence of live larvae. ECB mortality typically is very high during the first 3 to 5 days after egg hatch. Plant resistance, natural enemies, and adverse environmental conditions are major causes of ECB larval mortality.

**Sampling** Begin checking for whorl feeding damage when the plants with extended leaves are 17 inches. Randomly select 5 sets of 20 consecutive plants from throughout the field. Determine the percentage of plants that exhibit fresh whorl feeding. Note: newly hatched larvae feed on the leaves, causing a characteristic “window pane” or “shothole” type of damage that is readily visible as the whorl unrolls. In addition, dissect 2 infested plants from each sample of 20 plants and look for live larvae in the whorl of the stalk. Check weekly or more frequently.

**Decision Making.** Treatment is suggested if 80 percent or more of the plants exhibit whorl feeding damage and if 80 percent or more of the damaged plants (i.e., 8 out of the 10 dissected plants) have at least 1 live larva per plant.

### **Second Generation**

Although second generation ECB are more likely to attack corn that has been planted late, all corn grown for grain should be scouted when plants with extended leaves are 17 to 24 inches.

**Sampling.** To assess the potential for economic damage, begin scouting for egg masses when second generation moths emerge and begin egg-laying. The presence of ECB moths in areas bordering a field can be used to indicate a likely infestation. To survey for these moths, walk along the grassy sides of the field and look for large numbers of moths flying when disturbed. However, if no other information is available, it is suggested that scouting for egg masses be initiated the last week of June and continued at 2 to 3 day intervals through the third week of July. Randomly select 5 sets of 20 consecutive plants from throughout the field. Count the number of egg masses found on each plant. ECB moths usually lay their eggs in masses on the undersides of leaves, 2 or 3 leaves below the ear; however, because they can be laid anywhere, it is suggested that every leaf be inspected for egg masses.

**Decision Making.** To reduce a potential economic loss from second generation ECB in field corn grown for grain, an insecticide treatment is warranted if 35 percent or more of the plants in the pre- to post-tasseling stage of development have at least 1 egg mass per plant.

## General Guidelines for Use of Bt Corn in Virginia

Specific cotton-growing counties in Virginia, where corn growers who plant Bt corn hybrids for corn borers or other lepidopterous insects (such as cutworms, armyworms, etc.) also must plant a 50 percent non-Bt corn refuge.

The Virginia counties subject to the 50 percent corn refuge requirement are: Dinwiddie, Franklin City, Greensville, Isle of Wight, Northampton, Southampton, Suffolk City, Surry, and Sussex.

### **What Is Bt Corn?**

A Bt corn hybrid refers to a corn plant that has been genetically engineered to express a crystalline protein derived from a common soil bacterium, *Bacillus thuringiensis*. Bt genes are also commonly called “traits.” Although researchers have identified numerous strains of Bt proteins, only a handful have been incorporated into the current lines of commercial corn hybrids. Bt proteins are highly toxic to European corn borer, meaning that all Bt corn hybrids labeled for caterpillar pests are effective against this pest. Resistance to Cry1F was documented in Canada. Single-trait Bt hybrids (e.g., Herculex I) are not recommended in Virginia.

### **European Corn Borer Life Cycle**

European corn borer is a moth that has two main generations per year in Virginia. It overwinters as a fifth instar larva inside pieces of corn stalks, and it has a host range of over 200 plant species. The main damage caused by corn borer larvae results from tunnels bored into the stalk about two weeks before silking. A cornfield that averages one or more tunnels per stalk can expect a yield reduction of about 5%. Despite the fact that it is relatively simple to scout for this pest during the growing season, few growers in Virginia actually do. Their main reasons for not scouting are based on years of observing low levels of stalk breakage and ear drop at harvest.

### **What Other Corn Pests Are Controlled by Bt Hybrids?**

Some Bt traits are effective against multiple caterpillar pests. These traits can be regionally ineffective in areas, including Virginia, where resistance has been documented or is suspected. The Handy Bt Trait Table published by Chris DiFonzo at Michigan State University provides a list of corn trait names and their current insect protection benefits - <https://www.texasinsects.org/bt-corn-trait-table.html>.

## General Guidelines for Planting Bt Corn Borer Hybrids in Virginia

1. Most corn ( $\geq 90\%$ ) planted timely in Virginia (i.e., from April to early May) will likely not realize an economic benefit from Bt corn because of the lack of European corn borer pressure early in the season.
2. It is strongly recommended that Bt corn be planted anywhere late-planted corn (i.e., corn planted mid- to late May or later) is grown in Virginia because of the increasing risk of corn borer damage.

## EPA Refuge Requirements for Planting Bt Corn Hybrids

Refuge requirements vary by hybrid and by region. Use label to determine requirements in your area.



**Table 4.20 - European Corn Borer (ECB)**

<b>Insecticide (Formulation)</b>	<b>Amount active ingredient per acre</b>	<b>Amount product per acre</b>	<b>Time limits: days before harvest</b>	<b>Remarks</b>
beta-cyfluthrin (Baythroid XL)	0.0125-0.022 lb	1.6-2.8 oz	grain or fodder: 21 Green forages after last application: 0	<b>RESTRICTED USE.</b> Application must be made prior to the larva boring into the plant. Maximum product per 7-day interval: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Maximum number of applications per season: 4.
bifenthrin zeta-cypermethrin (Hero [1.24 lb AI/gal prod])	0.04-0.1 lb	4.0-10.3 oz	30 grain and stover, 60 forage	<b>RESTRICTED USE.</b> For grain, silage, and seed. Do not apply more than 0.4 lb AI/A/season for foliar applications. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply if heavy rainfall is imminent.
chlorantraniliprole (Prevathon 0.43 SC)	0.047-0.067 lb	14-20 oz	14 for ears	
esfenvalerate (Asana XL)	0.04-0.05 lb	7.8-9.6 oz	21	<b>RESTRICTED USE.</b> <b>First generation:</b> Apply when eggs are in blackhead stage or starting to hatch. Ground application suggested— use 20-30 gal carrier/A and direct spray to both sides of leaves. <b>Second generation:</b> Apply when eggs are in blackhead stage or starting to hatch. Good coverage above, below, and in the ear zone is essential.
lambda-cyhalothrin (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	21	<b>RESTRICTED USE.</b> Must be applied before larva bores into stalk. Apply as required by scouting, usually at intervals of 7 or more days. Apply by ground or air using sufficient water for full coverage. <b>Aerial application:</b> use ≥2 gal water/A. Do not apply >0.48 pt/A/season. Do not apply >0.24 pt/A after silk initiation. Do not apply >0.12 pt/A after milk stage.
methoxyfenozide (Intrepid 2 F)	0.06-0.25 lb	4-16 oz	21	Must be applied before borers enter stalk.
spinosad (Blackhawk 4 SC)	0.038-0.075	1.67-3.3 oz	28 grain	Must be applied before borers enter stalk. Use 25 GPA minimum and at most 30 psi.
zeta-cypermethrin (Mustang Maxx)	0.017-0.025 lb	2.72-4.0 oz	7 grain, stover, and forage	<b>RESTRICTED USE.</b> Use minimum 10 gal water/A.

## Grasshoppers

### Grasshopper Sampling/Decision Making

Damage may occur during mid- to late-summer, especially during periods of drought. Examine fields next to pastures and other grassy areas where grasshoppers overwinter and develop. Treatment of these adjacent breeding sites before the young grasshoppers move into the corn field may reduce the area that must be sprayed later. Treatment of non-cropped areas is suggested when young grasshoppers reach 20 per square yard. Treat field margins when young grasshoppers enter the field from roadsides. Treatment of entire field is seldom necessary; however, field sprays may be justified when 5 to 8 grasshoppers per square yard are present during the silking period.

**Table 4.21 - Grasshoppers**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.0165-0.022 lb	2.1-2.8 oz	grain or fodder: 21 Green forages after last application: 0	<b>RESTRICTED USE.</b> Maximum product per 7-day interval: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Maximum number of applications per season: 4.
bifenthrin zeta-cypermethrin (Hero [1.24 lb AI/gal prod])	0.025-0.026 lb	2.6-6.1 oz	30 grain and stover, 60 forage	<b>RESTRICTED USE.</b> For grain, silage, and seed. Do not apply more than 0.4 lb AI/A/season for foliar applications. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply if heavy rainfall is imminent.
esfenvalerate (Asana XL)	0.03-0.05 lb	5.8-9.6 oz	21	<b>RESTRICTED USE.</b> Apply as necessary to maintain control.
lambda-cyhalothrin (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	21	<b>RESTRICTED USE.</b> Apply as required by scouting. Apply by ground or air using sufficient water for full coverage. <b>Aerial application:</b> use $\geq 2$ gal water/A.
zeta-cypermethrin (Mustang Maxx)	0.017-0.025 lb	2.72-4.0 oz	7 grain, stover, and forage	<b>RESTRICTED USE.</b> Use minimum 10 gal water/A.

## Spider Mite

### **Spider Mite Sampling/Decision Making**

Spider mite populations often seem to explode as plants reach the grain-fill period, especially during extended hot, dry weather when the plants are stressed. Broad-spectrum insecticides applied for other insect pests during mid-summer can devastate the mite predator complex and thus may increase mite populations. If corn has not dented, treatment may be warranted if mite colonies are present along the midribs on the lower surfaces of one-third to one-half of the leaves on 50 percent of the plants. This can also be expressed as 15 to 20 percent of the total leaf area covered with mite colonies, and mites are beginning to colonize significant areas of the field. Do not apply miticides if heavy rainfall is imminent.

**Table 4.22 - Spider Mite**

<b>Insecticide (Formulation)</b>	<b>Amount active ingredient per acre</b>	<b>Amount product per acre</b>	<b>Time limits: days before harvest</b>	<b>Remarks</b>
etoxazole (Zeal)	0.045 to 0.135 oz	1.0 to 3.0 oz	21	Read and follow all label instructions.
fenpyroximate (Portal)	0.10 lb	2.0 pints	14	Read and follow all label instructions.

## Corn Leaf Aphid

### Corn Leaf Aphid Sampling/Decision Making

Aphids are rarely a problem because infestations either build up too late, or they are controlled by beneficial insects such as lady beetles, lacewings, and parasitic wasps. Economic infestations may occur in mid-summer inside the leaf whorl surrounding the developing tassel. If treatment is considered it should be applied before 50 percent of the tassels emerge to be most effective. Unfold the whorl leaves of 20 plants at each of 5 locations in the field and note the severity of aphid colonies and any natural enemy activity. Treatment may be needed when 25 percent of the plants are heavily infested and natural enemy activity is low. Corn yield is not affected by the aphid-transmitted barley yellow dwarf virus (BYDV). However, it is important to note that corn can be infected with BYDV and serve as a focal point for the virus to spread into neighboring small grains.

**Table 4.23 - Corn Leaf Aphid**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
bifenthrin zeta-cypermethrin (Hero [1.24 lb AI/gal prod])	0.04-0.1 lb	4.0-10.3 oz	30 grain and stover, 60 forage	<b>RESTRICTED USE.</b> For grain, silage, and seed. Do not apply more than 0.4 lb AI/A/season for foliar applications. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply if heavy rainfall is imminent.
lambda-cyhalothrin (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	21	<b>RESTRICTED USE.</b> Suppression only. Apply as required by scouting, usually at intervals of 7 or more days. Apply by ground or air using sufficient water for full coverage. <b>Aerial application:</b> use $\geq 2$ gal water/A. Do not apply $>0.48$ pt/A/season. Do not apply $>0.24$ pt/A after silk initiation. Do not apply $>0.12$ pt/A after milk stage.
zeta-cypermethrin (Mustang Maxx)	0.017-0.025 lb	2.72-4.0 oz	7 grain, stover, and forage	<b>RESTRICTED USE.</b> Use minimum 10 gal water/A.

## Japanese Beetle

### Japanese Beetle (Adult Feeding) Sampling/Decision Making

Damage is caused when the adult beetles prevent pollination by clipping silks during the early stage of silking. Begin scouting in mid-July before pollination to determine the number of beetles present and the potential for silk clipping damage. Pollination takes place during a period of about 36 hours. If the silks are wilted and/or have turned brown, pollination is complete and further silk feeding will not affect yields. Examine 20 plants in each of 5 locations in the field to determine the stage of pollination, the number of beetles per plant, and the percentage of plants with silks cut back to 0.5 inch or less. An insecticide application may be necessary if 50 percent of the plants have silks cut back to 0.5 inch or less, there is an average of more than 3 Japanese beetles per silk, and the plants are still pollinating.

**Table 4.24 - Japanese Beetle**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.0125-0.022 lb	1.6-2.8 oz	grain or fodder: 21 Green forages after last application: 0	<b>RESTRICTED USE.</b> Maximum product per 7-day interval: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Maximum number of applications per season: 4.
bifenthrin zeta-cypermethrin (Hero [1.24 lb AI/gal prod])	0.04-0.1 lb	4.0-10.3 oz	30 grain and stover, 60 forage	<b>RESTRICTED USE.</b> For grain, silage, and seed. Do not apply more than 0.4 lb AI/A/season for foliar applications. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply if heavy rainfall is imminent.
lambda-cyhalothrin (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	21	<b>RESTRICTED USE.</b> Apply as required by scouting. Apply by ground or air using sufficient water for full coverage. <b>Aerial application:</b> use $\geq 2$ gal water/A.
zeta-cypermethrin (Mustang Maxx)	0.017-0.025 lb	2.72-4.0 oz	7 grain, stover, and forage	<b>RESTRICTED USE.</b> Use minimum 10 gal water/A.

## Brown Stink Bug

No-till fields are at higher risk for seedling injury. Brown stink bugs migrate from wheat fields just prior to, or following, harvest. Stink bug feeding on larger plants can cause developing ears to deform or abort. Virginia Tech recommends a threshold of one stink bug per four plants when the ear is forming and one stink bug per two plants from pollen shed to blister stage. Treatment past the blister stage is not recommended. Stink bugs will congregate near edges, but infestations of an entire field are possible. Walk at least 15 rows into the field to scout for bugs. Bugs will hide in leaf collars and in the whorl. Apply insecticides to stages just prior to tasseling. Results from aerial applications are variable - sprays can be effective or offer very poor control. Communicate with your applicator that you intend to target stink bugs prior to making an application. There is little to no residual with stink bug sprays and bugs can easily reinvade fields following sprays.

**Table 4.25 - Recommended Postemergence Insecticides to Control Stink Bugs**

<b>Insecticide (Formulation)</b>	<b>Amount active ingredient per acre</b>	<b>Amount product per acre</b>	<b>Time limits: days before harvest</b>	<b>Remarks</b>
beta-cyfluthrin (Baythroid XL 1.0 EC)	0.022 lb	2.8 oz	21	
bifenthrin (Brigade 2 EC, others)	0.10 lb	6.4 oz	30	
bifenthrin + zeta-cypermethrin (Hero 1.24 EC)	0.1 lb	10.3 oz	60 forage 30 grain and stover	
bifenthrin + zeta-cypermethrin (Steed 1.5 EC)	0.055 lb	4.7 oz	60 forage 30 grain and stover	
cyfluthrin (Tombstone 1.0 EC)	0.044 lb	2.8 oz	21	
lambda-cyhalothrin (Karate Z, Warrior II 2.08CS)	0.03 lb	1.92 oz	21	
zeta-cypermethrin (Mustang Maxx 0.8 EC)	0.025 lb	4.0 oz	30	

## Brown Marmorated Stink Bug

Brown marmorated stink bugs (BMSB) feed through the husk of corn ears with their piercing mouthparts, causing shriveled kernels. BMSB may rapidly re-infest a treated area.

**Table 4.26 - Recommended Postemergence Insecticides to Control Brown Marmorated Stink Bug**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
Bifenthrin (Bifenture EC)	0.1 lb	6.4 oz	30	<b>RESTRICTED USE.</b> 12 hour re-entry interval. Toxic to fish and aquatic organisms.
Methomyl (Lannate SP) (Lannate LV)	0.45 lb 0.45 lb	0.5 lb 1.5 pt	3 forage 21 grain and stover	<b>RESTRICTED USE.</b> 48 hour re-entry interval. Do not apply more than 2.5 lb Lannate SP or more than 7.5 pt Lannate LV/acre/crop.





## Small Grains

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### True Armyworm

#### Sampling

Armyworms are easier to control when they are small. However, their presence is often noticed when severe damage is noticed. Check fields once each week starting the 2nd week of May. It may be necessary to begin scouting earlier following a warm winter and/or early spring. Examine first the debris and undergrowth on the ground surface along field margins and lodged areas. Armyworm frass or droppings also may be found on the soil surface. If small armyworms are present in these areas, obtain 10 to 20 armyworm counts in a 3-foot row at 50-pace intervals throughout the field. Note the average size of the worms, and whether any defoliation of the flag leaf and/or head clipping has occurred.

#### Decision Making

Natural enemies such as parasites, pathogens, insect predators, and birds usually keep armyworm populations in check in small grains. The effectiveness of these natural control agents is reduced during cool, wet springs and during growing seasons that follow years of drought.

As a general rule, barley should be treated if the number of armyworms exceeds one per linear foot between rows and most of the worms are greater than 0.75-inch long. In wheat, armyworms tend to nibble on the tips of kernels rather than clip heads; thus, populations of two to three worms per linear foot between rows are required to justify control. In high management wheat fields with 4-inch rows, treatment is recommended when armyworm levels exceed 3 to 5 per square foot of surface area, or per linear foot of row.

Note that wheat fields with mixed infestations of armyworms and sawfly caterpillars may need treatment even if worm counts of each pest do not exceed threshold levels. Also, if the grain crop is close to harvest or the majority of armyworms are longer than 1.5 inches and no head clipping has occurred, control may not be needed.

**Table 4.27 - Recommended Insecticides for Armyworm Control**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.014-0.019 lb	1.8-2.4 oz	30	Do not graze or forage within 7 days. (1 <sup>st</sup> and 2 <sup>nd</sup> instar)
chlorantraniliprole (Prevathon)	0.047-0.067 lb	14.0-20.0 oz	1	
chlorantraniliprole + lambda-cyhalothrin (Besiege)	0.05-0.098 lb	6.0-10.0 oz	30	<b>RESTRICTED USE.</b>
lambda-cyhalothrin (Warrior II)	0.02-0.03 lb	1.28-1.92 oz	30	<b>RESTRICTED USE.</b> Do not apply more than 3.84 oz per acre per season.
spinetoram (Radiant SC)	0.023-0.047 lb	3.0-6.0 oz	21	Do not apply within 21 days of grain or straw harvest or within 3 days of forage, fodder, or hay harvest.
spinosad (Blackhawk)	0.025-0.075 lb	1.1-3.3 oz	21	Barley, buckwheat, oats, rye, triticale, wheat. Do not apply within 21 days of grain or straw harvest or within 3 days of forage, fodder, or hay harvest.

**Table 4.27 - Recommended Insecticides for Armyworm Control (cont.)**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
zeta-cypermethrin (Mustang Maxx)	0.011-0.025 lb	1.76-4.0 oz	14	<b>RESTRICTED USE.</b>

## Aphids

### *Grain Aphids at Tillering during Fall and Early Spring*

#### **Sampling**

Grain aphids (several species) usually are held in check by their natural enemies, which include predators, parasites, and fungal diseases. When looking for aphids, it is important to recognize these natural enemies. Check grain fields each week starting in the fall or early spring if damage symptoms are evident. Infestations of aphids, particularly the greenbug and corn leaf aphid, occasionally build up in the fall. Symptoms are often first noticed as circular, yellow to brown spots with dead plants in the center. These spots may increase in size if the infestation is allowed to persist. To determine aphid activity on tillering grain, examine 20 sites throughout the field. Each site should consist of at least 5 linear feet of a row. Look at areas in the field that are showing plant stress symptoms. Aphid damage may be confused with moisture stress and/or nitrogen deficiency. Count the number of aphids on small plants and, if aphids are numerous, estimate the numbers per linear foot of a row of larger plants. Make a tally of the proportion of each species, particularly if greenbugs are present. Bird cherry-oat aphids and English grain aphids have been associated with barley yellow dwarf virus (BYDV) infections in winter wheat in the past few years. Yellowing and reddening of leaves are the most typical BYDV symptoms. However, laboratory testing would be needed to confirm infections, as symptoms resemble those of other conditions in small grains.

#### **Decision Making**

Treatment during the fall and early spring is not often necessary, but may be needed if infestations are threatening and the weather is unusually mild. Treatment is suggested if aphid counts exceed 150 per linear foot of row throughout the majority of the field and a low degree of beneficial insect activity is present. The greenbug can be the most destructive because of the toxic substances it secretes during feeding, so maintain close surveillance of fields if this aphid is the predominate species. One exception to the treatment threshold applies to wheat under intensive-management practices grown in Virginia, where the transmission of viral diseases (BYDV, or other cereal viruses) by aphids is more prevalent. Treatment of intensive management wheat in Virginia is suggested based on the following threshold table:

**Table 4.28 - Aphid Numbers**

Time of year	Suggested number needed to treat
<b>Fall</b>	
Plant until spring growth begins	15-25/row-foot and yellowing areas scattered throughout the field.
<b>Spring</b>	
After spring growth resumes until hard-dough stage	100/row-foot, plants 3-6 inches tall 200/row-foot, plants 7-10 inches tall 300/row-foot, plants 11+ inches tall
<b>Heading</b>	20-25/grain head

## **Grain Aphids During the Grain Head Stage**

### **Sampling**

To determine aphid activity after the grain heads form, count the number of aphids on 100 heads throughout the field. Do not bias sampling by checking a few heads along the field margins where infestations usually are higher. Check for natural enemies at the same time that aphids are being counted. Aphids usually are clustered as colonies among bracts of the grain head and may move slightly when disturbed. Anything that actively moves when disturbed is probably a predator. Make a note of the ratio of predators to aphids.

### **Decision Making**

The need for treatment depends primarily on the number of aphids, plant maturity, and the presence of natural enemies. Treatment during the grain head stage is generally considered when aphid numbers exceed more than 25 per head, especially if the crop is late, when cool weather is forecast and the natural enemy complex is lacking. Control is not advised if the crop is approaching the hard dough stage where there is good predator/parasite activity. Ratios of one or more predators to every 50 to 100 aphids are sufficient to achieve biological control.

**Table 4.29 - Recommended Insecticides for Aphid Control**

<b>Insecticide (Formulation)</b>	<b>Amount active ingredient per acre</b>	<b>Amount product per acre</b>	<b>Time limits: days before harvest</b>	<b>Remarks</b>
<i>Seed Treatments</i>				
imidacloprid (Gaucho XT)	0.43-0.57 oz	3.4-4.5 oz/cwt	N/A	Do not graze or feed livestock on treated areas for 45 days after planting.
(Gaucho 600 FS)	–	0.8-2.4 oz/cwt	N/A	
thiamethoxam (Cruiser 5FS)	–	0.75-1.33 oz/cwt	N/A	
<i>Foliar Treatments</i>				
beta-cyfluthrin (Baythroid XL)	0.014-0.019	1.8-2.4 oz	30	Do not graze or forage within 3 days.
dimethoate (Dimethoate 4EC)	0.25-0.38 lb	0.5-0.75 pt	35	Do not apply within 14 days of grazing. Labeled for use on wheat only. Do not make more than 2 applications/season.
(Dimethoate 2.67EC)	0.25-0.5 lb	0.75-1.5 pt	35	
lambda-cyhalothrin (Warrior II)	0.02-0.03 lb	1.28-1.92 oz	30	<b>RESTRICTED USE.</b> Do not apply more than 3.84 oz per acre per season.
lambda-cyhalothrin + thiamethoxam (Endigo ZC)	0.023+0.03 lb - 0.031+0.04 lb	3.5-4.5 oz	30	<b>RESTRICTED USE.</b> Barley only. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 30 days after treatment.
zeta-cypermethrin (Mustang Maxx)	0.02-0.025 lb	3.2-4.0 oz	14	<b>RESTRICTED USE.</b> Wheat and triticale only. Aids in control.

## **Cereal Leaf Beetle**

Cereal leaf beetle infestations are rare and sporadic in Virginia since at least 2016. Automatic sprays of insecticides tank-mixed with fungicide applications are likely to be unnecessary and or mistimed because of increasing annual temperatures. This practice is accelerating the evolution of pyrethroid resistance in brown stink bug, and other non-economic species in small grains. Broad-spectrum insecticide applications can also remove natural enemies, resulting in other pest outbreaks (e.g., cereal aphids).

### **Sampling**

In many areas of the mid-Atlantic states, cereal leaf beetle eggs are heavily parasitized; thus, the larval stage is the best indicator of the potential yield loss. Cereal leaf beetle development is temperature dependent. Once a week, make field inspections of wheat starting in early May and of spring oats starting by mid-May. It may be necessary to begin scouting earlier following a warm winter and/or early spring. Scouting reports from 2017 and 2018 indicated that sampling is necessary beginning in mid-April. Examine the flag leaf of wheat or the entire tiller of oats on 5 plants at each of 10 locations in the field. Count the number of larvae per flag leaf or tiller and note any defoliation.

### **Decision Making**

A number of introduced parasites have been instrumental in keeping cereal leaf beetle populations below economic damage levels. Also, favorable planting dates may help suppress populations. Wheat planted early in the fall immediately after the Hessian fly-free date will be more advanced in growth the next spring than late-planted small grains. These early plantings will be less attractive to and more tolerant of the beetles when they peak in the spring. Cereal leaf beetle infestations on spring-planted oats cannot be avoided by means of planting date. Generally, barley is more advanced in maturity and thus less attractive when beetles are active.

Adults move into small grain in late February and early March and deposit eggs which hatch into larvae. Larvae feed on grain stripping leaves of valuable photosynthetic tissue. Research indicated that damage to both flag and stem leaves reduces yield. Best control is achieved if treatments are applied when larvae are small. Treatment should be considered if 25, total, eggs and small larvae are found on 100 stems. Of that 25, at least 1/2 should be larvae. Once wheat reaches the hard dough stage, beetle damage has little effect on yield and controls are not needed.

**Table 4.30 - Recommended Insecticides for Cereal Leaf Beetle Control**

<b>Insecticide (Formulation)</b>	<b>Amount active ingredient per acre</b>	<b>Amount product per acre</b>	<b>Time limits: days before harvest</b>	<b>Remarks</b>
beta-cyfluthrin (Baythroid XL)	0.008-0.014 lb	1.0-1.8 oz	30	Do not graze or forage within 3 days.
lambda-cyhalothrin + thiamethoxam (Endigo ZC)	0.023+0.03 lb - 0.031+0.04 lb	3.5-4.5 oz	30	<b>RESTRICTED USE.</b> Barley only. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 30 days after treatment.
lambda-cyhalothrin (Warrior II)	0.02-0.03 lb	1.28-1.92 oz	30	<b>RESTRICTED USE.</b> Do not apply more than 3.84 oz per acre per season.
spinetoram (Radiant SC)	0.016-0.047 lb	2.0-6.0 oz	21	Do not apply within 21 days of grain or straw harvest or within 3 days of forage, fodder, or hay harvest.
zeta-cypermethrin (Mustang Maxx)	0.011-0.025 lb	1.76-4.0 oz	14	<b>RESTRICTED USE.</b> Wheat and triticale only.

## Hessian Fly

The Hessian fly is not a major pest in the mid-Atlantic states because small grains normally are planted after the adult flies occur (“fly-safe” date). There are no insecticidal control measures that can be applied once the field becomes infested. Control is based entirely upon prevention and host plant resistance (i.e., resistant varieties). The important components of preventative fly management include: planting wheat only after the fly-safe planting date; destroying volunteer wheat plants by tillage methods; and planting resistant varieties, especially when planting very early. Check the following tables for the fly-safe dates in your area and contact your local Extension agent for information on resistant varieties. In Virginia, it is generally thought that the fly-safe date is around Oct. 20. However, flies can infest fields planted after that date by moving from volunteer grain plants in or from nearby fields.

**Table 4.31 - Safe Planting Dates**

<i>Maryland counties</i>					
Anne Arundel	Oct. 7	Dorchester	Oct. 9	Queen Anne’s	Oct. 7
Allegany	Sept. 27	Frederick	Oct. 2	St. Mary’s	Oct. 9
Baltimore	Oct. 2	Garrett	Sept. 20	Somerset	Oct. 10
Calvert	Oct. 8	Harford	Oct. 1	Talbot	Oct. 8
Caroline	Oct. 7	Howard	Oct. 2	Washington	Oct. 1
Carroll	Sept. 28	Kent	Oct. 6	Wicomico	Oct. 10
Cecil	Oct. 3	Montgomery	Oct. 4	Worcester	Oct. 11
Charles	Oct. 8	Prince George’s	Oct. 7		
<i>Delaware counties</i>					
New Castle	Oct. 3	Kent	Oct. 8	Sussex	Oct. 10

## Brown Stink Bug

Large populations of brown stink bug may develop in small grains during May and June. There is no evidence that their feeding is capable of significantly reducing yields. Migration into surrounding corn may be problematic following harvest. Sprays targeting stink bug in small grains to prevent movement into corn are ineffective and, thus, not recommended.

## Sorghum

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### Seedling Pests

Sorghum should not be considered a low input crop in terms of insect control. Regular scouting, especially of late-planted fields, is strongly recommended. In addition to spraying for sugarcane aphid, budget one insecticide application for headworms.

Wireworms, billbugs and sugarcane beetles have the potential to infest Virginia sorghum. There are several factors that may predispose your crop to infestation including reduced tillage, soil with high organic matter, lack of rotation from corn/sorghum, presence of nutsedge or other grassy weeds, and planting in late April-early May. Alternative management practices that may help to reduce the risk of infestations and damage include a high-vigor crop, tillage, rotation and weed management.

**Note:** Seed treatments are generally not recommended for Virginia sorghum due to the lack of early-season pests and short window of product activity.

**Table 4.32 - Insecticide Seed Treatments for Sorghum**

Insecticide	Active ingredient	Application rate	Target Species
Poncho Votivo	clothianidin + bacillus firmus	6.13 fl oz/100 lb seed (0.08 mg ai/seed) based on 13,500 seed/pound	aphid (including yellow sugarcane aphid and corn leaf aphid), wireworm, chinch bug, white grub
NipsIT INSIDE	clothianidin	5.1 to 6.4 fl oz/100 lb seed	aphid (including yellow sugarcane aphid and corn leaf aphid), wireworm, chinch bug, white grub
Cruiser 5FS	thiamethoxam	5.1 to 7.6 fl oz per 100 pounds of seed (0.062-0.093 mg ai/seed) based on 14,500 seed/pound	aphid (including yellow sugarcane aphid and corn leaf aphid), wireworm, fire ant, seed corn maggot

### Aphids

Several aphid species may be found on Virginia sorghum including white sugarcane aphid (*Melanaphis sacchari*), a species that was first detected in Virginia in 2015. Heavy infestations can stunt or kill sorghum plants that are in the pre-head stage, and after heading the honeydew can interfere with mechanical harvest by plugging up combines. Resistant varieties provide protection against this pest.

Yellow sugarcane aphid (*Sipha flava*) and corn leaf aphid (*Rhopalosiphum maidis*) can infest sorghum alone or in combination with white sugarcane aphid. These aphids are rarely worth concern—they provide food for beneficial natural enemies!

### Sampling/Decision Making

All sorghum grown in Virginia is at risk for sugarcane aphid. Late-planted fields, both grain and forage varieties, are at very high risk. Sugarcane aphid typically infests in July and August. It is important to scout sorghum at least weekly for this pest. Scout at least twice a week once this species is found since treatment should be applied quickly once threshold is reached. Start with field edges, especially checking the underside of lower leaves. Aphids will infest borders first. Aphids are seldom evenly distributed across a field, so examine plants from all parts of the field. Leaves that are shiny with honeydew indicate that aphids are present on that plant. Aphids are found on the underside of leaves. A general threshold is 25% of plants infested. Thresholds by growth stage are provided in Table 1 based on North Carolina Cooperative Extension recommendations. Good coverage is essential, a minimum spray volume of 10 gal/A is recommended and repeat applications (if needed) should rotate chemistries.

**Note:** Pyrethroids are not effective against white sugarcane aphid and are harmful to natural enemy populations, thus should be avoided for this species.

**Table 4.33 - Economic Thresholds for Treatment of Sugarcane Aphid in Sorghum**

Growth stage	Threshold
Pre-boot and Boot	20% infested plants with localized area of honeydew and established aphid colonies
Flowering milk, Soft dough, and Dough	30% infested plants with localized area of honeydew and established aphid colonies
Black layer	Heavy honeydew and established aphid colonies in head (treat to avoid problems at harvest). <b>Note:</b> Check product label for pre-harvest interval.

*Thresholds in this table are from Sugarcane Aphid Now Present in NC-2016 <https://entomology.ces.ncsu.edu/2016/07/sugarcane-aphid-now-present-in-nc-2016/> by Dr. Dominic Reisig, Associate Professor and Extension Specialist, NCSU.*

**Table 4.34 - Insecticides Recommended for the Control of White Sugarcane Aphid in Sorghum**

Insecticide	Active ingredient	Application rate (oz/A)	Max annual application rate (oz/A/year)	Pre-harvest interval (days)
Sivanto Prime <sup>1</sup>	flupyradifurone	4-7 (foliar)	28	7 (forage) and 21 (grain)
Sefina	afidopyropen, cyclopropanecarboxylate	6	12	7 (forage) and 14 (grain)
Transform WG	sulfoxaflor	0.75-1.5	3.0	7 (forage) and 14 (grain)

<sup>1</sup>Section 2(ee) use recommendation valid until December 31, 2025.

For more information on the sugarcane aphid, please contact your local extension agent. Contact information can be found at <http://www.ext.vt.edu/offices/index.html>.

## Headworms (corn earworm, fall armyworm, and sorghum webworm)

### Sampling/Decision Making

Control of caterpillar pests in pre-headed sorghum is rarely necessary, even with 40-60% leaf injury. Treat only when 75-100% of plants are infested. Headworms (e.g., armyworm, corn earworm, sorghum webworm) routinely infest grain heads. Begin to sample for worms soon after flowering by beating heads of 10 consecutive plants into a 5-gallon bucket or net. Check multiple locations in a field. Recommended thresholds are two corn earworm or fall armyworm per head or five sorghum webworm. Open headed sorghum accumulates less damage than closed-headed types. Coverage can be an issue when spraying sorghum. Pyrethroids offer poor to moderate control of corn earworm and fall armyworm in Virginia. If you decide to spray a pyrethroid, use the highest labeled rate and do not expect good control of heavy infestations or large worms.

### Sorghum Midge

Damaging infestations of sorghum midge are rare. However, Virginia is in the known range of this pest and heavy infestations of this pest can be damaging to sorghum in the bloom period. Adult midges are flies that are orange or reddish in color and 1.3-1.6 mm in length. Larvae are spindle-shaped and range in color from colorless (small larvae) to pink to red-orange (full-grown).

### Sampling/Decision Making

Adult midges do not damage sorghum, but midge larvae feed on and destroy developing seeds. To determine the presence of sorghum midge, fields should be inspected during midmorning until shortly after noon when midges are most active. During the sorghum bloom period, inspect fields daily or every other day to detect sorghum midges. Scout for midges by clapping the head



between your hands and inspecting palms for dead flies (i.e., orange spots). Thresholds are one fly per head. Midge resistant sorghum hybrids are available commercially and, within limits, provide an additional management tool. At similar infestation levels of ovipositing midge females, resistant hybrids generally suffer one-third the damage that susceptible sorghum hybrids suffer. The antibiosis resistance increases the economic threshold level to five adults per head during flowering compared with one midge per head for susceptible hybrids.

## Stink Bugs

Several species of stink bug may infest Virginia sorghum including green, brown and potentially the invasive brown marmorated. Stink bugs usually move onto sorghum soon after flowering. Stink bugs have sucking mouthparts and feed on developing seed within the panicle. Their feeding will shrivel seed thereby reducing seed size and quality. They also may feed on stems and other plant parts but the main damage is from kernel (seed) feeding. Sorghum is most susceptible during the milk and soft dough stage. Injury normally is not damaging from hard dough to maturity.

## Sampling/Decision Making

Sample for stink bugs along with headworms (method described above). Treat if combined numbers of all stink bugs (large nymphs and adults) exceeds 2-4 bugs per head during milk stage or 4-8 bugs per head during soft dough stage.

**Note:** Some insecticides recommended for stink bug control may control headworms. In general, pyrethroids will offer poor to moderate control of headworms. Not all insecticides recommended for headworms such as spinosad (Tracer™) are effective against stink bug.

Insecticide	Active ingredient	Application rate	Pre-harvest interval	Target species
Baythroid XL 1EC	beta-cyfluthrin	1.0-1.3 fl oz/A	14	Sorghum midge
		1.3-2.8 fl oz/A		Headworms (armyworm 1 <sup>st</sup> and 2 <sup>nd</sup> instar only), stink bugs, flea beetle
Asana XL	esfenvalerate	2.9-5.8 fl oz/A	21	Sorghum midge
		5.8-9.6 fl oz/A <b>Note:</b> Do not apply >29 fl oz (0.15 lb ai)/A/season.		Corn earworm
Tombstone	cyfluthrin	1.0-1.3 fl oz/A	14	Sorghum midge
		1.3-2.8 fl oz/A <b>Note:</b> Do not apply >2.8 fl oz (0.044 lb ai)/10 day interval. Do not apply >8.4 fl oz (0.131 lb ai)/A/season.		Headworms (armyworm 1 <sup>st</sup> and 2 <sup>nd</sup> instar only), stink bugs, flea beetle
Warrior II 2.08EC	lambda-cyhalothrin	1.28-1.92 fl oz/A	30	Headworms, stink bugs
		0.96-1.28 fl oz/A		Sorghum midge
Mustang Maxx	zeta-cypermethrin	1.76-4.0 fl oz/A	14 grain and stover, 45 forage	Headworms, stink bugs
		1.28-4 fl oz/A		Sorghum midge

## 4-50 Insect Control in Field Crops: *Sorghum*

**Table 4.35 - Foliar Insecticides for Sorghum (cont.)**

Insecticide	Active ingredient	Application rate	Pre-harvest interval	Target species
Beseige	lambda-cyhalothrin + chlorantraniliprole	6.0 – 10.0 fl oz/A	30	Headworms, stink bugs
		5.0-6.0 fl oz/A		Sorghum midge
Prevathon	chlorantraniliprole	14-20 fl oz/A	1	Headworms
Tracer, Blackhawk	spinosad	Tracer: 1.5-3 fl oz/A	7 grain, 14 forage	Headworms
		Blackhawk: 1.7-3.3 oz/A	21 grain, 3 forage	
Sevin XLR Plus, Sevin 4F	carbaryl	2.0-4.0 pt/A <b>Note:</b> Direct spray into forming heads.	21 grain, 14 grazing or silage	Headworms
Lannate LV, Lannate 90SP, Nudrin LV, Nudrin SP	methomyl	0.75-1.5 pt/A (LV) 0.25-0.5 lb/A (SP)	14	Headworms, Sorghum midge
		1.5 pt/A (LV) 0.5 lb/A (SP)		Sorghum webworm

## **Soybeans**

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### **Essentials of a Good Soybean Insect Pest Management Program**

#### **Know Soybean Insect Pests**

It is very important that you know how to identify common soybean insect pests, and when they are most likely to occur. Different pest species have different economic thresholds and can require different insecticides for effective control. Various Virginia Cooperative Extension publications are available that can be useful in identifying insect pests. Also, consult your local Extension agent or state Extension specialist.

#### **Know Pest Economic Thresholds**

An economic threshold is the number of a particular insect pest that must be controlled to prevent economic loss to the crop. Thresholds have been established through many scientific studies. Thresholds provide a starting place when making control decisions. Consider health of crop, development stage, profit potential, and insecticide costs before applying insecticides. A treatment before a pest has reached its economic threshold usually will not pay and may cause an increase in other pests, requiring a second insecticide treatment. Sub-threshold populations may cycle out or be controlled by beneficial predators - do not assume threshold populations will be reached when pests are present at low levels.

#### **Know What Crop Growth Stages Are Most Susceptible to Insect Attack**

Leaf feeding insects can attack soybeans at almost any time during the season. Full-season and double-crop planting systems react differently to this leaf damage. Yield is highly related to total leaf area, as measured by LAI (leaf area index). To achieve maximum yield potential, soybeans must develop an LAI of 3.5 to 4.0 or above. An easy way to visualize LAI is to think of a field with an LAI of 4 having 4 acres of leaf area for every acre of ground. Any leaf canopy above that can be removed (i.e., by insect leaf feeders) without reducing the yield potential. Most full-season plantings achieve larger leaf canopies and LAIs, regardless of the climatic conditions (temperature, cloud cover, or rainfall) and are tolerant of leaf feeding. Double-crop plantings do not always achieve as large a leaf canopy and can be more sensitive to defoliation. Leaf percent defoliation thresholds (30% prior to bloom, 15% from flowering to pod fill, 35% after pod fill) should only be applied to full-season plantings, or double-crop plantings with large canopies. Be more conservative with double-crop plantings without large canopies due to very late planting, dry conditions, poor soil, or other factors.

#### **Know What Conditions Predispose Soybeans to Insect Injury**

Corn earworm damage is typically most severe in fields with open canopies, ones having flowers or young pods, or fields under some degree of drought or nematode stress. Double crop soybeans or soybeans planted in fields affected by drought or nematodes should be watched more closely. In dry seasons, all fields should be watched more closely.

#### **Stay Informed of Current Pest Status**

A corn earworm advisory is issued weekly to Virginia Cooperative Extension agents from August through September. These advisories summarize current moth activity as monitored by a system of blacklight and pheromone traps. Earworm infestations, if they occur, will most likely follow peak moth activity periods by 8 to 10 days. Stay informed about the moth situation in your area and intensify your scouting efforts during critical periods.

#### **Scout Field Regularly**

Scouting (described below) is an essential part of successful economic management of insect pests. You must know what kind and how many insects are in your fields before making treatment decisions. **Do not apply insecticides unless you have confirmed that a real problem exists in your fields.**

## Mexican Bean Beetle, Green Cloverworm, Bean Leaf Beetle

### Sampling

Mexican bean beetles, although rare and sporadic, may infest soybeans as soon as the plants emerge, and first examine the field margins next to overwintering areas. Feeding injury usually is not evenly distributed during the early season. Count the number of beetles over a 3-foot section of row in at least five locations in the infested area. Estimate the level of stand reduction if seedlings are killed, or estimate the percentage of defoliation on older plants. Bean leaf beetles also may cause damage to young soybean plants. These insects prefer tender plant tissue and leave rounded holes on leaves. This type of leaf injury is distinguishable from the lacelike injury caused by Mexican bean beetles.

Mexican bean beetle and green cloverworm infestations usually do not reach economic levels before August. Early-planted, full-season soybeans usually attract more colonizing beetles than do later fields. However, double-crop fields may become infested with adults that are moving out of maturing fields late in the season in search of more succulent foliage. Start scouting for both insect pests at least weekly during late July through September. Examine the entire field because larval populations may be localized. Check the undersides of leaves on plants and keep a tally of the number of egg masses, young larvae, older larvae, pupae, and adults. When possible, use a drop cloth to determine numbers in fields with wide rows. Estimate defoliation to the nearest 10 percent on 20 to 30 plants selected throughout the field. Each plant should be pulled up to examine the total leaf area; not just the upper canopy leaves.

When sampling, remember to check for diseased or parasitized larvae because the natural enemies play an important role in controlling these pests. Clover worms are killed by a fungal disease which causes larvae to become hard, mummified, and covered with powdery white to light green spores. The presence of diseased worms usually signals the decline of the pest population.

### Decision Making

Spray only when Mexican bean beetles and/or leaf-feeding caterpillars are actively feeding. At seedling, spray when defoliation reaches 40 percent with 2 to 3 beetles per plant throughout the field. At prebloom, spray when defoliation exceeds 30 percent, with 20 or more adults and/or larvae per 3-foot row. At bloom and podset, spray when defoliation exceeds 15 percent, with 16 or more adults and/or larvae per 3-foot of row. Consider the relative size and age composition of the population. If eggs and pupae of the Mexican bean beetle are the predominant stages it is advisable to wait until egg hatch or adult emergence before treating. Also consider the presence of natural controls, such as cloverworms infected with fungal disease or parasitized Mexican bean beetle larvae (mummies).

**Table 4.36 - Recommended Insecticides for Mexican Bean Beetle, Green Cloverworm, and Bean Leaf Beetle Control**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
acephate (Orthene 97)	0.73-0.97 lb	0.75-1.0 lb	14	Do not graze or cut vines for hay or forage. Do not exceed 1.5 lbs/A of product per season.
beta-cyfluthrin (Baythroid XL) (Mexican bean and bean leaf beetle)	0.013-0.022 lb	1.6-2.8 oz	21 (seed)	<b>RESTRICTED USE.</b> Green forage may be fed 15 days after last application.
(green cloverworm)	0.0065-0.0125 lb	0.8-1.6 oz		
beta-cyfluthrin + imidacloprid (Leverage 360)	0.02-0.04 lb	2.8 oz	21 (seed)	<b>RESTRICTED USE.</b> Dry vines (hay) and green forage may be fed 15 days after last application.
bifenthrin (Brigade 2EC)	0.033-0.1 lb	2.1-6.4 oz	18	<b>RESTRICTED USE.</b>
bifenthrin + chlorantraniliprole (Elevest)	0.084-0.167 lb	4.8-9.6 oz	18	<b>RESTRICTED USE.</b> Apply higher labeled rates within the listed range for heavier infestations, larger/denser crops or extreme environmental conditions such as rainy weather and high temperatures.

**Table 4.36 - Recommended Insecticides for Mexican Bean Beetle, Green Cloverworm, and Bean Leaf Beetle Control (cont.)**

<b>Insecticide (Formulation)</b>	<b>Amount active ingredient per acre</b>	<b>Amount product per acre</b>	<b>Time limits: days before harvest</b>	<b>Remarks</b>
chlorantraniliprole (Prevathon) (green cloverworm)	0.047-0.067 lb	14.0-20.0 oz	1	Not labelled for use against bean leaf beetle or Mexican bean beetle. Apply higher rates within the listed range for heavier infestations, larger/denser crops or extreme environmental conditions such as rainy weather and high temperatures.
(Vantacor)	0.047-0.098 lb	1.2-2.5 oz	1	
esfenvalerate (Asana XL) (bean leaf beetle)	0.015-0.03 lb 0.03-0.05 lb	2.9-5.8 oz 5.8-9.6 oz	21	<b>RESTRICTED USE.</b> Do not feed or graze livestock on treated plants. Do not exceed 0.2 lb ai per acre per season. Extremely toxic to fish.
indoxacarb (Steward EC) (green cloverworm) (bean leaf beetle)	0.045-0.11 lb 0.09-0.11 lb	4.6-11.3 oz 9.2-11.3 fl oz	21	Do not feed or graze livestock on treated fields. Not labeled for use against Mexican bean beetle. Suppression only against bean leaf beetle.
lambda-cyhalothrin + chlorantraniliprole (Besiege)	0.016 + 0.033 lb- 0.026 + 0.052 lb	5.0-8.0 oz	30	<b>RESTRICTED USE.</b> Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
lambda-cyhalothrin (Warrior II)	0.015-0.025 lb	0.96-1.6 oz	30	<b>RESTRICTED USE.</b> Do not apply more than 7.68 oz per acre per season. Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
methomyl (Lannate LV) (green cloverworm and Mexican bean beetle)	0.12-0.225 lb	0.4-0.75 pt	14 (seed)	<b>RESTRICTED USE.</b> Wait 3 days to feed or graze as forage or 12 days for hay. Up to 2 applications may be used.
(Lannate SP) (green cloverworm and Mexican bean beetle)	0.11-0.225 lb	0.125-0.25 lb	14	
(Lannate LV) (bean leaf beetle)	0.225-0.3 lb	0.75-1.0 pt	14	
(Lannate SP) (bean leaf beetle)	0.225-0.34 lb	0.25-0.375 lb	14	
methoxyfenozide (Intrepid 2F) (green cloverworm)	0.06-0.12 lb	4.0-8.0 oz	7 (hay/forage) 14 (seed)	Not labeled for use against bean leaf beetle or Mexican bean beetle.
spinetoram (Radiant SC) (green cloverworm)	0.15-0.31 lb	2.0-4.0 oz	28	Not labeled for use against bean leaf beetle or Mexican bean beetle.
spinosyn (Blackhawk) (green cloverworm)	0.025-0.05 lb	1.1-2.2 lb	28	Do not feed treated forage or hay to meat or dairy animals. Not labeled for use against bean leaf beetle or Mexican bean beetle.

**Table 4.36 - Recommended Insecticides for Mexican Bean Beetle, Green Cloverworm, and Bean Leaf Beetle Control (cont.)**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
thiamethoxam + lambda-cyhalothrin (Endigo ZC) (bean leaf beetle)	0.064-0.072 lb	4.0-4.5 oz	30	<b>RESTRICTED USE.</b> Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
(Mexican bean beetle and green cloverworm)	0.056-0.064 lb	3.5-4 fl oz		
zeta-cypermethrin (Mustang Maxx)	0.0175-0.025 lb	2.8-4.0 oz	21	<b>RESTRICTED USE.</b> Do not graze or harvest treated soybean forage, straw, or hay for livestock feed. Use higher labeled dosage for increased bean leaf beetle pressure, increased residual bean leaf beetle control, or later-season applications.

## Thrips

### Sampling/Decision Making

Thrips rarely require treatment; however, early season injury to drought-stressed plants may rarely reduce yields. Both nymphs and adults feed on the undersides of the leaves, causing small, silvery streaks and whitish or yellowish discoloration. Treatment may be required when injury appears on drought-stressed plants and more than eight thrips per leaflet are found. Treatment is not recommended in non-stressed fields because soybeans can tolerate thrips injury. Insecticidal seed treatments are not recommended in Virginia because there is no evidence that they protect yield even under high thrips pressure.

**Table 4.37 - Recommended Insecticides for Thrips Control**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
acephate (Orthene 97)	0.24-0.49 lb	0.25-0.5 lb	14	Do not graze or cut vines for hay or forage. Do not exceed 1.5 lbs/A of product per season.
beta-cyfluthrin (Baythroid XL)	0.007-0.013 lb	0.8-1.6 oz	21	<b>RESTRICTED USE.</b> Green forage may be fed 15 days after last application.
bifenthrin (Brigade 2EC)	0.033-0.1 lb	2.1-6.4 oz	18	<b>RESTRICTED USE.</b>
clothianidin + ipconazole + metalaxyl (Nipsit Inside + Rancona Xxtra)	—	4.78 oz/cwt		Seed treatment. Do not graze or feed soybean forage and hay to livestock.
imidacloprid (Gaucho 600)	.78-1.56 oz/cwt	1.6-3.2 oz/cwt	N/A	Seed treatment. Do not apply a neonicotinoid insecticide within 45 days of planting seed treated with Cruiser 5FS.
methomyl (Lannate LV)	0.225-0.3 lb	0.75-1.0 pt	14 (seed)	<b>RESTRICTED USE.</b> Wait 3 days to feed or graze as forage or 12 days for hay. Up to two applications may be used per season. See resistance statement on label under <b>DIRECTIONS FOR USE</b> section.
(Lannate SP)	0.225-0.34 lb	0.25-0.375 lb	14 (seed)	

**Table 4.37 - Recommended Insecticides for Thrips Control (cont.)**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
thiamethoxam (Cruiser 5FS)	0.8 oz/cwt	1.28 oz/cwt	N/A	Seed treatment.
zeta-cypermethrin (Mustang Maxx)	0.02-0.025 lb	3.2-4.0 oz	21	<b>RESTRICTED USE.</b> Aids in control. Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

## Potato Leafhopper

### Sampling/Decision Making

Leafhoppers attack soybeans during late June through July but rarely reach population levels that affect yields. Using a standard 15-in sweep net, take five sweeps in each of five locations in the field. Count the number of leafhoppers and empty the net before proceeding to the next location. A single sweep consists of a swath of the net along the row in the top one-third of the plant in one direction only.

The symptoms of leafhopper injury include localized stippling, curling, and yellowing of leaf margins. Treatment is suggested when injury appears and infestations exceed four leafhoppers per sweep in stressed beans or eight leafhoppers per sweep in normal growing fields. Dense pubescent varieties are less susceptible.

**Table 4.38 - Recommended Insecticides for Potato Leafhopper Control**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
acephate (Orthene 97)	0.49-0.97 lb	0.5-1.0 lb	14	Do not graze or cut vines for hay or forage. Do not exceed 1.5 lbs/A of product per season.
beta-cyfluthrin (Baythroid XL)	0.007-0.013 lb	0.8-1.6 oz	21	<b>RESTRICTED USE.</b> Green forage may be fed 15 days after last application.
bifenthrin (Brigade 2EC)	0.033-0.1 lb	2.1-6.4 oz	18	<b>RESTRICTED USE.</b>
esfenvalerate (Asana XL)	0.015-0.03 lb	2.9-5.8 oz	21	<b>RESTRICTED USE.</b> Do not feed or graze livestock on treated plants. Do not exceed 0.2 lb ai per acre per season. Extremely toxic to fish.
lambda-cyhalothrin + chlorantraniliprole (Besiege)	0.016 + 0.033 lb – 0.026 + 0.052 lb	5.0-8.0 oz	30	<b>RESTRICTED USE.</b> Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
lambda-cyhalothrin (Warrior II)	0.015-0.025 lb	0.96-1.6 oz	30	<b>RESTRICTED USE.</b> Do not apply more than 7.68 oz per acre per season. Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
thiamethozam + lambda-cyhalothrin (Endigo ZC)	0.056-0.064 lb	3.5-4.0 oz	30	<b>RESTRICTED USE.</b> Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
zeta-cypermethrin (Mustang Maxx)	0.0175-0.025 lb	2.8-4.0 oz	21	<b>RESTRICTED USE.</b> Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

## Spider Mites

### Sampling/Decision Making

Mite outbreaks usually are associated with hot, dry weather, which accelerates reproduction and development. During periods of high humidity and field moisture, a fungal disease can reduce populations but high temperatures can nullify these effects. Outbreaks also are associated with the application of certain insecticides that kill natural enemies and/or seem to make the soybean plant more nutritionally suitable for mites.

Check weekly for mites, starting in early July through August, especially during a hot, dry season. Concentrate on the field borders and look for the early signs of white stippling at the bases of the leaves. Do not confuse mite damage with dry weather injury, mineral deficiencies, and herbicide injury. If feeding injury is evident, press the undersides of a few damaged leaves on white paper to reveal any crushed mites. Determine the extent of the infestation and assess the level of injury by examining 20 to 30 plants in the infested area. Field infestations often show defoliated or injured plants at some localized point, with injury becoming less evident and extending in a widening arc into the field.

If isolated spots of mite activity are confined to the perimeter of the field, spot-treatment using ground equipment is recommended to prevent further spread of mites into the field. If the infestation is distributed throughout the interior of the field, treatment of the entire field is suggested if live mites are numerous (20 to 30 per leaflet) and more than 50 percent of the plants show stippling, yellowing, or defoliation over more than one-third of the leaves. If rains come, mite development and survival will decrease but may not drop to economic levels if heavy populations are developing under high temperatures. Broad-spectrum insecticide applications to control mites (e.g., bifenthrin, and dimethoate) will worsen mite infestations following initial reductions in numbers. Only use these materials when favorable weather (rain and or high humidity) is anticipated. Etoxazole is recommended for this reason.

**Table 4.39 - Recommended Insecticides for Spider Mite Control**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
bifenthrin (Brigade 2EC)	0.08-0.1 lb	5.12-6.4 oz	18	<b>RESTRICTED USE.</b>
dimethoate (Dimethoate 2.67EC)	0.4-0.5 lb	1.3-1.5 pt	21	Do not feed or graze within 5 days of the last application. Do not store above 90° F or below 32° F.
(Dimethoate 4EC)	0.5 lb	1.0 pt	21	
etoxazole (Zeal SC)	0.045-0.135 lb	2.0-6.0 oz	*	*Do not apply after R5 stage. Do not graze or feed forage or hay to livestock after application.

## Corn Earworm

### Sampling

Outbreaks often follow a midsummer drought, which causes the corn to ripen earlier and become less attractive to the moths. Female moths prefer to lay eggs in open-canopied, late-blooming fields. Drought conditions also delay soybean maturity and prevent normal canopy growth, so peak moth activity is more coincidental with blooming of open-canopied fields.

Sampling for corn earworm should be done on a weekly basis from July through September. If row spacing is 30 inches or greater any of the techniques described below can be used to sample for insects. Narrow-row beans, 21 inches or less, are best sampled with either the sweep net or rigid beat cloth. Concentrate on high-risk fields, such as ones that have open canopies, are late flowering, or were previously treated with insecticides.



### Standard Beat or Ground Cloth

For each sample, place a standard 3-foot ground cloth on the ground between rows and shake the plants bordering both sides vigorously. The number of insects shaken onto the cloth will be the number per 6 feet of row, so divide by 6 to get the number per row-foot. About ten samples should be taken in each 40 acre area. Thresholds are based on number of earworms per row-foot.

### Rigid Beat Cloth

The RBC works on the same principle as a standard beat cloth but the RBC is not flexible. Samples are taken by placing the sampler on its side between two rows of plants (plants cannot be seriously lodged) and beating or vigorously shaking adjacent plants into the sampler while it is leaned away from those plants at about a 45° angle. Two 7-inch rows are beaten and one 14-inch or 21-inch row is beaten per sample. Thresholds are based on the number of earworms *per sample*.

### Sweep Net

Each sample should consist of 15 net sweeps with a 15-inch diameter sweep net done continuously one after the other. Each sweep consists of swinging the net in one direction through the foliage so that the top of the net passes 2 or 3 inches below the tops of plants. Fifteen consecutive sweeps are done from one side to the other while walking down a middle row. Swing the net with enough force to dislodge insects into the net. If some leaves are not broken off and in the net after the sample, the sampler is not using enough force. Each swing should pass through the tops of 5, 3, or 2 rows in 7-inch, 14-inch, or 21-inch row-space plantings, respectively. After each sample, stop and count how many earworms are in the net. Thresholds are based on the number of earworms *per sample*.

### Decision Making

Treatment is suggested if sample counts exceed economic thresholds. Thresholds are presented at the end of this chapter. Visit the website <http://soybeans.ces.ncsu.edu/thresholds/> for access to the new threshold calculator.

**Table 4.40 - Recommended Insecticides for Corn Earworm Control**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
<i>Bacillus thuringiensis</i> (DiPel ES)	8.0-32.0 BCLUs	1.0-4.0 pts	0	For pyrethroid resistant corn earworms when tank-mixed with a pyrethroid at a labeled rate.
beta-cyfluthrin (Baythroid XL)	0.013-0.022 lb	1.6-2.8 oz	21	<b>RESTRICTED USE.</b> Green forage may be fed 15 days after last application.
beta-cyfluthrin + imidacloprid (Leverage 360)	0.02 + 0.04 lb	2.8 oz	21 (seed)	<b>RESTRICTED USE.</b> Dry vines (hay) and green forage may be fed 15 days after application.
bifenthrin (Brigade 2EC)	0.033-1.0 lb	2.1-6.4 oz	18	<b>RESTRICTED USE.</b>
bifenthrin + chlorantranilprole (Elevest)	0.084-0.167 lb	4.8-9.6 oz	18	<b>RESTRICTED USE.</b> Apply higher labeled rates within the listed range for heavier infestations, larger/denser crops or extreme environmental conditions such as rainy weather and high temperatures.
chlorantranilprole (Prevathon)	0.047-0.067 lb	14.0-20.0 oz	1	Apply higher labeled rates within the listed range for heavier infestations, larger/denser crops or extreme environmental conditions such as rainy weather and high temperatures.
(Vantacor)	0.047-0.098 lb	1.2-2.5 oz	1	
esfenvalerate (Asana XL)	0.02-0.03 lb	5.8-9.6 oz	21	<b>RESTRICTED USE.</b> Do not feed or graze livestock on treated plants. Do not exceed 0.2 lb per acre per season. Extremely toxic to fish.

## 4-58 Insect Control in Field Crops: Soybeans

**Table 4.40 - Recommended Insecticides for Corn Earworm Control (cont.)**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
indoxacarb (Steward EC)	0.045-0.11 lb	4.6-11.3 oz	21	Do not feed or graze livestock on treated fields.
lambda-cyhalothrin + chlorantraniliprole (Besiege)	0.016 + 0.033 lb -0.026 + 0.052lb	5.0-8.0 oz	30	<b>RESTRICTED USE.</b> Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
lambda-cyhalothrin (Warrior II)	0.015-0.025 lb	0.96-1.6 oz	30	<b>RESTRICTED USE.</b> Do not apply more than 7.68 oz per acre per season Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
methomyl (Lannate LV)	0.12-0.225 lb	0.4-0.75 pt	14 (seed)	<b>RESTRICTED USE.</b> Wait 3 days to feed or graze as forage or 12 days for hay. Up to two applications may be used/season.
(Lannate SP)	0.11-0.225 lb	0.125-0.25 lb	14 (seed)	
methoxyfenozide + spinetoram (Intrepid Edge)	0.078 + 0.015 0.125 + 0.025	4-6.4 oz	28 (seed)	Begin applications when first signs of feeding damage appear or when threshold levels of feeding damage occur.
spinetoram (Radiant SC)	0.15-0.31 lb	2.0-4.0 oz	28	
spinosyn (Blackhawk)	0.038-0.05 lb	1.7-2.2 oz	28	Do not feed treated forage or hay to meat or dairy animals.
thiamethoxam + lambda-cyhalothrin (Endigo ZC)	0.056-0.064 lb	3.5-4.0 oz	30	<b>RESTRICTED USE.</b> Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Note: thiamethoxam does not add increased activity against corn earworm over lamda-cyhalothrin alone.
zeta-cypermethrin (Mustang Maxx)	0.0175-0.025 lb	2.8-4.0 fl oz	21	<b>RESTRICTED USE.</b> Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

## Grasshopper

**Table 4.41 - Recommended Insecticides for Grasshopper Control**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
acephate (Orthene 97)	0.24-0.49 lb	0.25-0.5 lb	14	Do not graze or cut vines for hay or forage. Do not exceed 1.5 lbs/A of product per season.
bifenthrin + chlorantraniliprole (Elevest)	0.084-0.167 lb	4.8-9.6 oz	18	<b>RESTRICTED USE.</b> Time applications to target nymphs. Ensure good coverage. Methylated seed oil at the rate of 1 gallon per 100 gallons improves performance. Apply higher labeled rates within the listed range for heavier infestations, larger/denser crops or extreme environmental conditions such as rainy weather and high temperatures.

**Table 4.41 - Recommended Insecticides for Grasshopper Control (cont.)**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
cloranthraniliprole (Vantacor)	0.027-0.066 lb	0.7-1.7 oz	1	Time applications to target nymphs. Ensure good coverage. Methylated seed oil at the rate of 1 gallon per 100 gallons improves performance.
dimethoate (Dimethoate 4EC)	0.5 lb	1.0 pt	21	<b>RESTRICTED USE.</b> Do not feed or graze within 5 days of the last application. Do not store above 90°F or below 32°F.

## Armyworms

**Table 4.42 - Recommended Insecticides for Fall, Yellowstriped, and Beet Armyworm**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
acephate (Orthene 97) (except beet)	0.73-0.97 lb	0.75-1.0 lb	14	Do not graze or cut vines for hay or forage. Do not exceed 1.5 lbs/A of product per season.
beta-cyfluthrin (Baythroid XL) (fall armyworm and beet armyworm - 1st and 2nd instars only)	0.0125-0.022 lb	1.6-2.8 oz	21	<b>RESTRICTED USE.</b> Green forage may be fed 15 days after last application.
bifenthrin (Brigade 2EC)	0.033-0.10 lb	2.1-6.4 oz	18	<b>RESTRICTED USE.</b> Pyrethroid resistance is common for Beet Armyworm. Consult your local or state agricultural authority to identify resistance pest populations in your area. Refer to the resistance management statement in the <b>DIRECTIONS FOR USE</b> section on product label.
bifenthrin + chloranthraniliprole (Elevest)	0.098-0.167 lb	5.6-9.6 oz	18	<b>RESTRICTED USE.</b> Apply higher labeled rates within the listed range for heavier infestations, larger/denser crops or extreme environmental conditions such as rainy weather and high temperatures.
chloranthraniliprole (Prevathon) (Vantacor)	0.047-0.067 lb 0.047-0.098 lb	14.0-20.0 oz 1.2-2.5 oz	1 1	Apply higher labeled rates within the listed range for heavier infestations, larger/denser crops or extreme environmental conditions such as rainy weather and high temperatures.
indoxacarb (Steward EC)	0.045-0.11 lb	4.6-11.3 oz	21	Do not feed or graze livestock on treated fields.
lambda-cyhalothrin + chloranthraniliprole (Besiege)	0.026 + 0.052 lb 0.033 + 0.065 lb	8.0-10.0 oz	30	<b>RESTRICTED USE.</b> Use higher listed rates within the rate range for large larvae. Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

## 4-60 Insect Control in Field Crops: Soybeans

**Table 4.42 - Recommended Insecticides for Fall, Yellowstriped, and Beet Armyworm (cont.)**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
methomyl (Lannate LV) (Lannate SP)	0.225-0.3 lb 0.225-0.34 lb	0.75-1.0 pt 0.25-0.375 lb	14 (seed) 14 (seed)	<b>RESTRICTED USE.</b> Wait 3 days to feed or graze as forage or 12 days for hay. Up to two applications may be used per season.
methoxyfenozide (Intrepid 2F)	0.06-0.12 lb	4.0-8.0 oz	7 (hay/forage) 14 (seed)	
methoxyfenozide + spinetoram (Intrepid Edge)	0.078 + 0.015 0.125 + 0.025	4-6.4 oz.	28 (seed)	Begin applications when first signs of feeding damage appear or when threshold levels of feeding damage occur.
spinetoram (Radiant SC)	0.15-0.31 lb	2.0-4.0 oz	28	With the exception of yellowstriped armyworm and western yellowstriped armyworm.
spinosyn (Blackhawk)	0.038-0.05 lb	1.7-2.2 oz	28	Do not feed treated forage or hay to meat or dairy animals.
thiamethozam + lambda-cyhalothrin (Endigo ZC)	0.064-0.072 lb	4.0-4.5 oz	30	<b>RESTRICTED USE.</b> Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Use higher rates within the listed rate range for large larvae.
zeta-cypermethrin (Mustang Maxx) (beet and fall) (yellowstriped)	0.02-0.025 lb 0.0175-0.025 lb	3.2-4.0 oz 2.8-4.0 oz	21	<b>RESTRICTED USE.</b> Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

## Stink Bugs

Stink bugs are an important late-season pest of Virginia soybeans. Populations typically start to build in late-August and may be present in fields through October. Stink bug injury is economic primarily in R4 (full pod) and R5 (beginning seed). From R6 (full seed) on, double recommended thresholds. The stink bug complex in Virginia includes brown stink bug, green stink bug, brown marmorated stink bug, and, as of 2016, southern green stink bug. Pyrethroids control most species with the exception of brown stink bug. When brown stink bug is present, use either acephate or the high labeled rate of bifenthrin.

**Table 4.43 - Recommended Insecticides for Stink Bug Control**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
acephate (Orthene 97)	0.49-0.97 lb	0.5-1.0 lb	14	Do not graze or cut vines for hay or forage. Do not exceed 1.5 lbs/A of product per season.
beta-cyfluthrin (Baythroid XL)	0.0125-0.022 lb	1.6-2.8 oz	21	<b>RESTRICTED USE.</b> Green forage may be fed 15 days after last application.
beta-cyfluthrin + imidacloprid (Leverage 360)	0.02 + 0.04 lb	2.8 oz	21	<b>RESTRICTED USE.</b>
bifenthrin (Brigade 2EC)	0.033-0.1 lb	2.1-6.4 oz	18	<b>RESTRICTED USE.</b>

**Table 4.43 - Recommended Insecticides for Stink Bug Control (cont.)**

<b>Insecticide (Formulation)</b>	<b>Amount active ingredient per acre</b>	<b>Amount product per acre</b>	<b>Time limits: days before harvest</b>	<b>Remarks</b>
bifenthrin + chlorantraniliprole (Elevest)	0.084-0.167 lb	4.8-9.6 oz	18	<b>RESTRICTED USE.</b> Apply higher labeled rates within the listed range for heavier infestations, larger/denser crops or extreme environmental conditions such as rainy weather and high temperatures.
clothianidin (Belay)	0.05-0.1 lb ai/A	3.0-6.0 oz	21	Do not graze or feed soybean forage and hay to livestock.
esfenvalerate (Asana XL)	0.03-0.05 lb	5.8-9.6 oz	21	<b>RESTRICTED USE.</b> Do not feed or graze livestock on treated plants. Do not exceed 0.2 lb ai/A/season. Extremely toxic to fish.
lambda-cyhalothrin + chlorantraniliprole (Besiege)	0.026 + 0.052 lb – 0.033 + 0.065 lb	8.0-10.0 oz	30	<b>RESTRICTED USE.</b> Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
lambda-cyhalothrin (Warrior II)	0.025-0.03 lb	1.6-1.92 oz	30	<b>RESTRICTED USE.</b> Do not apply more than 7.68 oz/A per season. Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
thiamethozam + lambda-cyhalothrin (Endigo ZC)	0.064-0.072 lb	4.0-4.5 oz	30	<b>RESTRICTED USE.</b> Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
zeta-cypermethrin (Mustang Maxx)	0.02-0.025 lb	3.2-4.0 oz	21	<b>RESTRICTED USE.</b> Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

## Soybean Looper

Soybean loopers can completely defoliate a field in a short period of time, in as few as 5-7 days if numbers are extremely high (i.e., 1 or more larvae per sweep). Large populations of soybean looper may develop in mid-August through September. Adult moths migrate from the southern US and can be pushed ahead of weather fronts or arrive earlier following higher than normal temperatures. We do not have a threshold specific to loopers in Virginia, but lump them into a general leaf defoliators ‘guild’ which can include many leaf eaters (Japanese beetles, green cloverworms, grasshoppers, bean leaf beetles and others). Base a treatment decision on the total leaf area destroyed by the guild. We recommend not treating fields with fully developed seed unless 35-40% of the leaf area is eaten and bugs are still present.

Do not use a pyrethroid to treat for soybean loopers. These products will only worsen infestations. Spray trial results and resistance screening assays indicate that products containing chlorantraniliprole are becoming less effective. As of 2022, products containing indoxacarb, methoxyfenozide, spinosyn, and spinetoram provide the most consistent control.

## 4-62 Insect Control in Field Crops: Soybeans

**Table 4.44 - Recommended Insecticides for Soybean Looper Control**

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
bifenthrin + chlorantraniliprole (Elevest)	0.098-0.167 lb	5.6-9.6 oz	18	<b>RESTRICTED USE.</b> Apply higher labeled rates within the listed range for heavier infestations, larger/denser crops or extreme environmental conditions such as rainy weather and high temperatures.
chlorantraniliprole (Prevathon)	0.047-0.067 lb	14.0-20.0 oz	1	Apply higher labeled rates within the listed range for heavier infestations, larger/denser crops or extreme environmental conditions such as rainy weather and high temperatures.
(Vantacor)	0.047-0.098 lb	1.2-2.5 oz	1	
indoxacarb (Steward EC)	0.045-0.11 lb	4.6-11.3 oz	21	Use lower rate (4.6 fl oz/A) for low to moderate populations of soybean looper. Use higher rates (5.6 fl oz/A to 11.3 fl oz/A) for higher populations or when crop canopy is dense.
lambda-cyhalothrin + chlorantraniliprole (Besiege)	0.033 + 0.065 lb	10.0 oz	30	Refer to Resistance Management section on product label. Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
methoxyfenozide (Intrepid 2F)	0.06-0.12 lb	4.0-8.0 oz	7 (hay/forage) 14(seed)	
methoxyfenozide + spinetoram (Intrepid Edge)	0.078 + 0.015 0.125 + 0.025	4-6.4 oz.	28 (seed)	Begin applications when first signs of feeding damage appear or when threshold levels of feeding damage occur.
spinetoram (Radiant SC)	0.15-0.31 lb	2.0-4.0 oz	28	
spinosyn (Blackhawk)	0.025-0.05 lb	1.1-2.2 oz	28	Do not feed treated forage or hay to meat or dairy animals.

## Soybean Aphid

The current economic threshold for aphids is an average of 250 aphids per plant, on two consecutive field visits spaced about 5-7 days apart. This is because aphid populations can “crash” quickly due to heavy pressure by natural enemies like lady beetles, parasitic wasps, and fungal diseases. When scouting, choose a “Z” or “W” shaped pattern to cover the entire field and sample at least 20 to 30 plants per field by examining the entire plant, including stems and upper and lower leaf surfaces. Use the aphid/plant average for determining the need for treatment. The threshold applies to soybeans through the R5 growth stage (3 mm long seed in the pod at one of the four uppermost nodes on the main stem), after which time plants can tolerate 1,000+ aphids with no threat to yield.

**Table 4.45 - Recommended Insecticides for Soybean Aphid Control**

<b>Insecticide (Formulation)</b>	<b>Amount active ingredient per acre</b>	<b>Amount product per acre</b>	<b>Time limits: days before harvest</b>	<b>Remarks</b>
acephate (Orthene 97)	0.73-0.97 lb	0.75-1.0 lb	14	Do not graze or cut vines for hay or forage. Do not exceed 1.5 lbs/A of product per season.
bifenthrin (Brigade 2EC)	0.033-0.1 lb	2.1-6.4 oz	18	<b>RESTRICTED USE.</b>
clothianidin (Belay)	0.05-0.1 lb ai/A	3.0-6.0 fl oz	21	Do not graze or feed soybean forage and hay to livestock. Soybean aphids need to be targeted when populations are less than or equal to 250 aphids/plant. Populations above threshold may need more than one treatment to achieve control. Choose lower rate for light infestation and higher rate for heavy infestation.
cyfluthrin (Baythroid XL)	0.044 lb	2.0-2.8 oz	21	<b>RESTRICTED USE.</b> Green forage may be fed 15 days after last application.
esfenvalerate (Asana XL)	0.03-0.05 lb	5.8-9.6 oz	21	<b>RESTRICTED USE.</b> Do not feed or graze livestock on treated plants. Do not exceed 0.2 lb per acre per season. Extremely toxic to fish. Tank mix with methomyl (e.g., Lannate) to achieve rapid knockdown of soybean aphids.
flupyradifurone (Sivanto 200SL)	0.09-0.137 lb	7.0-10.5 oz	21 (seed)	7 day PHI for forage and hay.
imidacloprid (Gaucho 600)	0.78-1.56 oz/cwt	1.6-3.2 oz/cwt	N/A	Seed treatment.
lambda-cyhalothrin + chlorantraniliprole (Besiege)	0.016 + 0.033 lb – 0.026 + 0.052 lb	5.0-8.0 oz	30	<b>RESTRICTED USE.</b> Use lower rates for early-season applications and/or lighter populations. Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
lambda-cyhalothrin (Warrior II)	0.015-0.025 lb	0.96-1.6 fl oz	30	<b>RESTRICTED USE.</b> Do not apply more than 7.68 oz per acre per season. Do not graze or harvest treated soybean forage, straw, or hay for livestock feed. Use lower rates for early season applications and/or lighter populations.
thiamethoxam (Cruiser 5FS)	0.61 fl oz ai/cwt	1.28 oz/cwt	N/A	Seed treatment.
thiamethozam + lambda-cyhalothrin (Endigo ZC)	0.056-0.064 lb	3.5-4.0 oz	30	<b>RESTRICTED USE.</b> Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Use lower rates for early season applications and/or lighter populations.
zeta-cypermethrin (Mustang Maxx)	0.0175-0.025 lb	2.8-4.0 oz	21	<b>RESTRICTED USE.</b> Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

## 4-64 Insect Control in Field Crops: Soybeans

### **Threecornered alfalfa hopper (3CAH)**

Adults are small (1/4-inch-long), green, wedge shaped insects that overwinter in plant debris, cover crops, and wooded areas. Nymphs are wingless, brown to green, and have spines along the top of their body. Adults may move to soybean as early as plant emergence. This insect feeds on plant sap and feeds around the mainstem of plants during the seedling state (<12 inches tall). Feeding occurs at the soil level. Resulting injury includes warts, calluses, and girdling of the stem. Girdled plants are highly susceptible to breaking and lodging during reproductive stages although some stand loss occurs in the seedling stage.

Early-season injury from 3CAH is more common in no-till fields following cover crops and or wheat. High organic matter soils are also associated with higher risk. Injury has been most severe in Virginia's piedmont region. Neonicotinoid seed treatments (i.e., thiamethoxam, clothianidin, imidacloprid) may provide some protection, but their benefit depends on growing conditions (faster growing plants will move through susceptible stages faster), insect pressure, and field size (smaller fields are at higher risk, larger fields may have injury confined to field borders). Seed treatments will encourage slug populations. Good agronomic practices are recommended to prevent or mitigate economic injury including early planting, burning down cover crops two to four weeks prior to planting, high seeding rates, and good plant stands.

There is no evidence that 3CAH can cause economic damage in plants taller than 12-inches. Scouting is based on visual examination and treatment is recommended when 10% of plants are infested. Populations can be high throughout the growing season and there are multiple generations per year in Virginia.

**Table 4.46 - Recommended Insecticides for Threecornered Alfalfa Hopper Control**

<b>Insecticide (formulation)</b>	<b>Amount active ingredient per acre</b>	<b>Amount product per acre</b>	<b>Time limits: days before harvest</b>	<b>Remarks</b>
acephate (Orthene 97)	0.75-1.0 lb	0.75-1.0 lb	14	Do not graze or cut vines for hay or forage. Repeat treatment as necessary to maintain control, but do not exceed 1.5 lbs/A of product per season.
pyrethroids – beta-cyfluthrin, bifenthrin, esfenvalerate, lambda-cyhalothrin, zeta-cypermethrin (various generic and non-generic products)	-	-	-	Reference table 4.44 for specific products and rates.



## Pest Thresholds

**Table 4.47 - Other Soybean Insect Pest Thresholds**

Pest species	# per row-foot row-spacing		# per 15 sweeps row-spacing		Other comments
	7"-21"	above 21"	7"-21"	above 21"	
<i>Full-season plantings</i>					
Mexican bean beetle	4	6	24	36	40% defoliation - pre-bloom, 15% defoliation - pod-fill, 35+% defoliation - fully developed seeds.
Spider mite	Damage occurring and live mites present				Live mites on 50% of leaves and 50% leaves showing white spotting or premature leaf drop.
Other defoliators <sup>1</sup>					40% defoliation - pre-bloom, 15% defoliation - pod-fill, 35+% defoliation - fully developed seeds.
<i>Double-crop plantings with poor growth</i>					
Mexican bean beetle	2	4	12	24	20% defoliation - pre-bloom, 15% defoliation - fully developed seeds.
Spider mite	Damage occurring and live mites present				Live mites on 50% of leaves and 50% leaves showing white spotting or premature leaf drop.
Other defoliators <sup>1</sup>					20% defoliation - pre-bloom, 10% defoliation - pod-fill, 15% defoliation - fully developed seeds.

<sup>1</sup>Other defoliators include any combinations of green cloverworm, bean leaf beetle, blister beetle, Japanese beetle, soybean looper, yellowstriped armyworm, grasshoppers, or fall armyworm.

**Table 4.48 - Revised Stink Bug Thresholds for Soybean (all stink bug species combined)**

Row spacing	# per row foot		# per 15 sweeps	
	7-21" rows	Above 21"	7-21" rows	Above 21"
New (Grain)	1-2	1-2	5	5
New (Seed)	0.5	0.5	2.5	2.5

Apply from R3-4 to R7, double after R7



## Peanuts

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### Thrips

Seedling peanut plants are usually attacked by thrips within the first six to eight weeks after planting. Risk of economic damage from thrips injury is increased whenever poor growing conditions occur early in the season (May-June). These tiny, spindle-shaped insects feed primarily within the developing, unfolded leaflets causing crinkling of the leaflets and stunting of the plants. Blackening of the small leaflets occurs with severe infestations and can be mistaken for chemical injury. Under favorable conditions, plants outgrow this injury with no reduction in yield or grade. However, the delay in vine growth from early season thrips injury may delay maturity. This, in combination with other injury, such as herbicide burn, can reduce yield.

Thrips can be controlled with systemic insecticides. Systemics are incorporated in the furrow with the seed at planting. Foliar treatments can be applied as needed after crop emergence. Foliar insecticides alone are not recommended for thrips control. During dry seasons or seasons with excessive rains, systemic insecticides may not give adequate thrips control due to poor uptake by the plants or leaching of chemicals from the soil. Foliar treatments may be warranted if systemics are ineffective, or if injury appears excessive. Foliar treatment is recommended when 25 percent of the leaves show thrips damage and pest populations are still active.

**Table 4.49 - Recommended Insecticides for Thrips Control**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	acephate (Orthene 97)	6.0-12.0 oz	14	Do not feed treated forage or hay to livestock or allow animals to graze treated areas. Apply 10 to 50 gallons of spray solution to per acre to foliage.
	Cyazypyr (Exirel)	13.5-20.5 oz	14	Suppression only. Should be used in conjunction with an effective thrips and tomato spotted wilt virus management program.
In-furrow	aldicarb (AgLogic 15G, AgLogic 15GG)	7 lb	90	<b>RESTRICTED USE.</b> Do not hog-off treated fields or allow livestock to graze in treated areas before harvest. Do not feed hay or vines to livestock. Immediately deep-disk any spills at row ends or elsewhere to ensure the granules are covered with a layer of soil.
	imidacloprid (Admire Pro)	7.0-10.5 oz	14	Apply as an in-furrow spray during planting directed on or below seed.
	phorate (Thimet 20G)	5.5 lbs /1000 ft row or maximum of 7.5 lb/A	90	<b>RESTRICTED USE.</b> Distribute granules evenly in the furrow. Do not graze or feed treated hay or forage to livestock.

### Potato Leafhopper

The potato leafhopper is a common pest of peanuts in Virginia. This small, wedge-shaped, light green to yellow insect damages the peanut plant by feeding on the undersides of leaves in a piercing-sucking manner. Injured leaf tips turn yellow first then brown and tend to curve downward. Toxins are also passed into plants at feeding sites. If enough damage is done, toxins can stop vine growth resulting in reductions in yield and grade. Injury may occur at any time from early June until the middle of August or later in some years. It is important to note that although late-season damage appears worse in some years, damage

## 4-68 Insect Control in Field Crops: *Peanuts*

done early in the season probably affects plant vigor and yield more. Systemic insecticides applied at planting time will usually control potato leafhoppers that occur early, but if no pegging-time insecticide is applied, it may be necessary to make foliar applications in July or early August.

Foliar treatments should be made only if needed. When 25% of the leaves show tip yellowing typical of leafhopper damage, and active adult and immature leafhoppers are seen, treat with an effective chemical. When foliar treatments are required, the first application usually is made about the middle of July, and the second about the first of August (if needed). If scheduled treatments are being made for control of leafspot, insecticides may be tank mixed. Do not include insecticides with all leafspot treatments. Too many insecticide applications, or applications later in the season, could cause spider mite populations to increase, especially in dry years after adjacent corn and weedy areas have been cut. Make leafhopper applications only when problems have been identified.

**Table 4.50 - Recommended Insecticides for Potato Leafhopper Control**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	acephate (Orthene 97)	12.0-16.0 fl oz	14	Do not feed treated forage or hay to livestock or allow animals to graze treated areas. Apply 10 to 50 gallons of spray solution to per acre to foliage.
	beta-cyfluthrin + imidacloprid (Leverage 360)	2.8 oz	14	<b>RESTRICTED USE.</b>
	bifenthrin (Brigade 2EC)	2.1-6.4 oz	14	<b>RESTRICTED USE.</b> Do not feed immature plants and peanut hay to livestock. Apply in a minimum of 10 gallons of finished spray per acre with ground equipment or 2 gallons of finished spray per acre by aircraft.
	esfenvalerate (Asana XL)	2.9-5.8 oz	21	<b>RESTRICTED USE.</b> Do not feed or graze livestock on treated vines. Do not exceed 29 oz/ season.
	fenpropathrin (Danitol 2.4EC)	6.0-10.6 oz	14	<b>RESTRICTED USE.</b> Do not graze or feed treated peanut vine forage or dried hay within 14 days of the last application. Do not exceed 2.6 pints total application/A/season.
	lambda-cyhalothrin (Warrior II)	0.96-1.6 oz	14	<b>RESTRICTED USE.</b> Do not apply more than 7.68 fl oz/A/season. Do not graze livestock in treated areas, or use treated vines or hay for animal feed.
	methomyl (Lannate LV) (Lannate SP)	0.75- 3.0 pt 0.25- 1.0 lb	21 21	<b>RESTRICTED USE.</b> Do not feed treated vines. Use higher rate for severe infestations.
	zeta-cypermethrin (Mustang Maxx)	1.76-4.0 fl oz	7	<b>RESTRICTED USE.</b> Do not graze livestock in treated areas. Do not use treated vines or hay for animal feed.

## Southern Corn Rootworm

Southern corn rootworm larvae, which is the immature stage of the spotted cucumber beetle, can cause extensive injury to the Virginia peanut grown under certain conditions. Rootworm larvae develop in the soil and feed directly on pegs and pods. Finding rootworms in the soil is very difficult and injury is often not detected until after peanuts are dug. Field selection and early-planting are the best strategies. Determining risk for southern corn rootworm should be done on a field-by-field basis. Decisions can be based on both field characteristics (soil type, irrigation) and past history of peanut fields. Adult beetles can be readily detected in peanut fields. Their presence in moderate to high numbers from mid-July to early August should be a warning that a problem could develop. Fields planted after May 15 are at highest risk. Fields at lowest risk are planted before May 2. Factors that delay peanut maturity (thrips and or herbicide injury, poor growing conditions) increase risk.

Knowledge of the past history of rootworm injury can also be useful in determining risk level. If injury has ever occurred in a field, it will likely occur in other years. Keep field records on the extent of pod and peg injury noticed at harvest time. Pay particular attention to fields with higher levels of organic matter and clay. Rootworms have a higher survival rate in those soils due to higher moisture holding capacity, and injury will typically be more severe than in “light” soils. Use the “Southern Corn Rootworm Risk Index” to aid you in deciding which fields are at high risk.

There are no labeled chemical treatments for rootworm larvae in peanut. Insecticides that include “southern corn rootworm” on the label are referring to the adult beetle only. It may not be possible to mitigate damage from larvae by targeting adults.

## Corn Earworm

Annual infestations of the corn earworm and fall armyworm occur in most Virginia peanut fields. Usually there is a single generation of each species per season. Worms feed on leaf tissue causing peanuts to look ragged; however, research has shown that one-third of peanut foliage can be lost at the normal time of corn earworm infestations (mid-August to early September) without loss of yield or grade. Scouting fields is the only way to determine if treatment is needed. Scout by reaching halfway across 2 row-feet of plants and shaking foliage vigorously towards the row middle. Repeat on the opposite row. Count the worms on the ground and repeat the sample in several spots in the field. Treatment is recommended if an average of 8 or more worms are found per sample, or 4 per row-foot.

If treatment is necessary, apply sprays using systems that provide good canopy penetration and coverage. If spider mites are already present in the field, use of some insecticides may allow for rapid build-up. Scout fields for treatment effectiveness and for possible increases in spider mite activity soon after applications. Pyrethroids may offer poor to moderate control of corn earworm in Virginia, but this is often adequate economic control. If you decide to spray a pyrethroid, use the highest labeled rate and do not expect good control of heavy infestations or large worms.

**Table 4.51 - Recommended Insecticides for Corn Earworm Control**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remark
Foliar <sup>1</sup>	acephate (Orthene 97)	12.0-16.0 oz	14	Do not feed treated forage or hay to livestock or allow animals to graze treated areas. Apply 10 to 50 gallons of spray solution to per acre to foliage.
	<i>Bacillus thuringiensis</i> (DiPel ES)	1.0-4.0 pt	0	For pyrethroid resistant corn earworm when tank mixed with a pyrethroid at a labeled use rate. Apply recommended rate when small larvae first appear and good coverage can be achieved.
	beta-cyfluthrin + imidacloprid (Leverage 360)	2.8 oz	14	<b>RESTRICTED USE.</b>

<sup>1</sup>**General** - Treat only if foliage loss is heavy (1/3 or more). Earworms are easier to control when they are less than 1/2 inch long.

## 4-70 Insect Control in Field Crops: *Peanuts*

**Table 4.51 - Recommended Insecticides for Corn Earworm Control (cont.)**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remark
Foliar <sup>1</sup> (cont.)	bifenthrin (Brigade 2EC)	2.1-6.4 oz	14	<b>RESTRICTED USE.</b> Do not feed immature plants and peanut hay to livestock. Apply in a minimum of 10 gallons of finished spray per acre with ground equipment or 2 gallons of finished spray per acre by aircraft.
	bifenthrin + chlorantraniliprole (Elevest)	5.6-9.6 fl oz	14	<b>RESTRICTED USE.</b> Do not feed green immature plants and peanut hay to livestock.
	chlorantraniliprole (Prevathon)	14.0-20.0 oz	1	Vantacor is a more concentrated product than Prevathon.
	(Vantacor)	1.2-2.5 oz	1	
	chlorantraniliprole + lambda- cyhalothrin (Besiege)	6.0-10 oz	14	<b>RESTRICTED USE.</b>
	esfenvalerate (Asana XL)	2.9-5.8 oz	21	<b>RESTRICTED USE.</b> Do not feed or graze livestock on treated vines. Do not exceed 29.0 oz/season.
	fenpropathrin (Danitol 2.4EC)	10.6-16.0 oz	14	<b>RESTRICTED USE.</b> Do not graze or feed treated peanut vine forage or dried hay within 14 days of the last application. Do not exceed 2.6 pints total application/A/season.
	indoxacarb (Steward EC)	6.7-11.3 oz	14	Do not feed or graze livestock on treated fields.
	lambda- cyhalothrin (Warrior II)	1.28-1.92 oz	14	<b>RESTRICTED USE.</b> Do not apply more than 7.68 fl oz/A/ season. Do not graze livestock in treated areas, or use treated vines or hay for animal feed.
	methomyl (Lannate LV)	0.75-3.0 pt	21	<b>RESTRICTED USE.</b> Do not feed treated vines. Lannate LV and SP has ovicidal and larvicidal control on corn earworm. Use higher rate for severe infestations.
	(Lannate SP)	0.25-1.0 lb	21	
	methoxyfen- ozide + spinetoram (Intrepid Edge)	4.0-8.0 OZ	7	Do not exceed 3 applications/season. Do not allow grazing of peanut hay.
	spinetoram (Radiant SC)	3.0-8.0 oz	3	Do not allow grazing of peanut hay.
	spinosyn (Blackhawk)	1.7-3.3 oz	3	Do not allow grazing of crop residue or harvest of crop residue for hay until 14 days after the last application.
	zeta- cypermethrin (Mustang Max)	3.2-4.0 oz	7	<b>RESTRICTED USE.</b> Do not graze livestock in treated areas. Do not use treated vines or hay for animal feed.

<sup>1</sup>**General** - Treat only if foliage loss is heavy (1/3 or more). Earworms are easier to control when they are less than 1/2 inch long.

**Table 4.52 - Recommended Insecticides for Fall Armyworm Control**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remark
Foliar <sup>1</sup>	acephate (Orthene 97)	12.0-16.0 oz	14	Do not feed treated forage or hay to livestock or allow animals to graze treated areas. Apply 10 to 50 gallons of spray solution to per acre to foliage.
	<i>Bacillus thuringiensis</i> (DiPel ES)	2.0-4.0 pt	0	For pyrethroid resistant corn earworm when tank mixed with a pyrethroid at a labeled use rate. Apply recommended rate when small larvae first appear and good coverage can be achieved.
	beta-cyfluthrin + imidacloprid (Leverage 360)	2.8 oz	14	<b>RESTRICTED USE.</b> Controls 1st and 2nd instar armyworms.
	bifenthrin (Brigade 2EC)	2.1-6.4 oz	14	<b>RESTRICTED USE.</b> Do not feed immature plants and peanut hay to livestock. Apply in a minimum of 10 gallons of finished spray per acre with ground equipment or 2 gallons of finished spray per acre by aircraft.
	bifenthrin + chlorantraniliprole (Elevest)	5.6-9.6 oz	14	<b>RESTRICTED USE.</b> Do not feed green immature plants and peanut hay to livestock.
	chlorantraniliprole (Prevathon)	14.0-20.0 oz	1	Vantacor is a more concentrated product than Prevathon.
	(Vantacor)	1.2-2.5 oz	1	
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	6.0-10.0 oz	14	<b>RESTRICTED USE.</b> Use higher listed rates within the rate range for large larvae.
	esfenvalerate (Asana XL)	9.6 oz	21	<b>RESTRICTED USE.</b> Suppression only. Do not feed or graze livestock on treated vines. Do not exceed 29.0 oz/season. For heavy infestations methomyl (e.g., Lannate) is recommended. See methomyl product label for instructions.
	fenpropathrin (Danitol 2.4EC)	10.6-16.0 oz	14	<b>RESTRICTED USE.</b> Do not graze or feed treated peanut vine forage or dried hay within 14 days of the last application. Do not exceed 2.6 pints total application/A/season.
	indoxacarb (Steward EC)	9.2-11.3 oz	14	
	lambda-cyhalothrin (Nufarm Lambda-Cyhalothrin 1EC)	2.56-3.84 fl oz	14	<b>RESTRICTED USE.</b> Use higher rate for larger larvae. Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
	methomyl (Lannate LV)	0.75-3.0 pt	21	<b>RESTRICTED USE.</b> Do not feed treated vines.
	(Lannate SP)	0.25-1.0 lb	21	

<sup>1</sup>**General** - Treat only if foliage loss is heavy (1/3 or more). Earworms are easier to control when they are less than 1/2 inch long.

## 4-72 Insect Control in Field Crops: *Peanuts*

**Table 4.52 - Recommended Insecticides for Fall Armyworm Control (cont.)**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remark
Foliar <sup>1</sup> (cont.)	methoxyfen- ozide + spinetoram (Intrepid Edge)	4.0-8.0 oz		Do not exceed 3 applications/season. Do not allow grazing of peanut hay.
	methoxyfenozide (Intrepid 2F)	6.0-10.0 oz	7	Apply when first signs of feeding damage appear or when threshold levels of feeding damage occur.
	spinetoram (Radiant SC)	3.0-8.0 oz	3	Do not allow grazing of peanut hay.
	spinosyn (Blackhawk)	1.7-3.3 oz	3	Do not allow grazing of crop residue or harvest of crop residue for hay until 14 days after the last application.
	zeta- cypermethrin (Mustang Maxx)	3.2-4.0 oz	7	<b>RESTRICTED USE.</b> Do not graze livestock in treated areas. Do not use treated vines or hay for animal feed. Aids in control. See resistance statement in <b>DIRECTIONS FOR USE</b> section of product label.

<sup>1</sup>**General** - Treat only if foliage loss is heavy (1/3 or more). Earworms are easier to control when they are less than 1/2 inch long.

## Spider Mite

Mites, which have become more numerous during the past several years, are especially injurious during hot, dry weather. While insecticides are very valuable in controlling leafhoppers, thrips, and worms, they may be responsible for destroying some of the natural enemies of spider mites and thus promoting the build-up of mite populations. Insecticides should be used **only when needed** for insect control. Tank mixes that include both fungicides and insecticides are more likely to allow spider mite build-up than when either material is used separately.

Spider mites feed mainly on the undersides of the leaves. They suck the juice from the foliage and cause the leaves to turn brown and eventually drop off. Heavy infestations usually occur first around the borders of peanut fields; then they spread inward throughout the fields. Avoid harvesting spider mite infested cornfields or mowing weedy areas next to peanut fields until peanuts are harvested. Spider mites will readily move into peanuts when corn dries down or is harvested. Be prepared to treat peanuts if adjacent corn is infested.

Broad spectrum applications of insecticides labeled for spider mite control (e.g., bifenthrin, fenprothrin) will flair populations after a initial reduction in numbers. Use these products with caution and only when favorable weather (i.e., rainfall, high humidity) are forecast.

**Important:** If you are going to treat, calibrate your equipment to deliver the right amount of pesticide per acre. Arrange and adjust the nozzles or spouts in a manner that will direct the chemical into the desired area to be treated. Adequate sprayer pressure (40 to 60 psi) will aid in getting chemicals in contact with the undersides of leaves and within denser foliage. Penetration of foliage with 20 to 30 gallons of water per acre is very important for the control of spider mites.



**Table 4.53 - Recommended Insecticides for Spider Mite Control**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	bifenthrin (Brigade 2EC)	5.12-6.4 oz	14	<b>RESTRICTED USE.</b> Do not feed immature plants and peanut hay to livestock. Apply in a minimum of 10 gallons of finished spray per acre with ground equipment or 2 gallons of finished spray per acre by aircraft.
	fenpropathrin (Danitol 2.4EC)	10.6-16.0 oz	14	<b>RESTRICTED USE.</b> Do not graze or feed treated peanut vine forage or dried hay within 14 days of the last application. Do not exceed 2.6 pints total application/A/season.
	fenpyroximate (Portal)	1.0-2.0 pt	1	
	propargite (Comite) (Omite 30WS)	2.0 pt 3.0-5.0 lb	14 14	Use a minimum of 20 gallons/A with ground equipment or 5 gallons by air. Make no more than 2 applications/year (either Comite OR Omite). Do not plant rotational crops within 6 months of last application. Do not feed hay to livestock.

## Lesser Cornstalk Borer

Lesser cornstalk borer is typically not a problem in Virginia peanut fields. However, it does thrive under hot dry conditions and can become a problem when those conditions continue for 3-4 weeks. Infestations will be most severe where soils are sandy and in high, well drained areas within fields. Larvae are 0.5 to 0.75 inch long and are banded with alternating brown and blue stripes. They wiggle vigorously when disturbed. Larvae feed by burrowing into main stems, lateral limbs, plant crowns, and pods and can do extensive damage, even kill plants. Larvae produce silk-and-sand web tubes, which are attached to pods or stems at the point of feeding. Evidence of web tubes is a sure sign of borer activity.

If weather conditions become favorable for borers, survey fields for damaged plants and larvae. If damage is obvious and active larvae are still present in 10% or more of the plants, treatment is recommended.

## Grasshopper

**Table 4.54 - Recommended Insecticides for Grasshopper Control**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	acephate (Orthene 97)	4.0-8.0 oz	14	Do not feed treated forage or hay to livestock or allow animals to graze treated areas. Apply 10 to 50 gallons of spray solution to per acre to foliage.
	bifenthrin (Brigade 2EC)	2.1-6.4 oz	14	<b>RESTRICTED USE.</b> Do not feed immature plants and peanut hay to livestock. Apply in a minimum of 10 gallons of finished spray per acre with ground equipment or 2 gallons of finished spray per acre by aircraft.
	"bifenthrin + chlorantraniliprole (Elevest)	4.8-9.6 oz	14	<b>RESTRICTED USE.</b> Performance is improved with the addition of Methylated Seed Oil (MSO) at 1 gallon per 100 gallons of spray volume. Do not feed green immature plants and peanut hay to livestock.
	esfenvalerate (Asana XL)	5.8-9.6 oz	21	<b>RESTRICTED USE.</b> Do not feed or graze livestock on treated vines. Do not exceed 29.0 oz/season.
	zeta-cypermethrin (Mustang Maxx)	3.2-4.0 oz	7	<b>RESTRICTED USE.</b> Do not graze livestock in treated areas. Do not use treated vines or hay for animal feed.

## Pesticide Usage Charts

Many pesticides control more than one pest. The three tables below summarize the effectiveness of some popular pesticides used at time of planting, at time of pegging, or as foliar treatments for the control of major insect pests which attack peanuts.

**Table 4.55 - Insecticide Activity of Products Applied at Time of Planting**

Chemical	Pests			
	Thrips	Leafhopper	Rootworm	Spider Mite
Orthene	E	Early	No	No
Thimet	G	Early	No	No

P=poor control, F=fair control, G=good control, E=excellent control, No=not labeled or no activity expected.

**Table 4.56 - Insecticide Activity of Foliar Treatments Applied when Pests Are Present**

Insecticide	Formulation <sup>1</sup>	Pest Species Controlled						
		Thrips	Leaf-hopper	Root-worm	Corn earworm	Fall army-worm	Lesser corn stalk borer	Spider mite
Asana	XI	No	E	No	F/P	G	No	No <sup>2</sup>
Comite, Omite	6.5EC, 30W	No	No	No	No	No	No	E
Danitol	2.4EC	No	E	No	E	G	No	E
Karate	Z	E	E	No	F/P	G	No	F
Lannate	L	P	G	No	E	G	No	No <sup>2</sup>
Orthene	97	E	E	No	G	F	No	No <sup>2</sup>
Sevin	4F, 80s, XLR Plus	P	E	No	F	F	No	No <sup>2</sup>
Steward	1.25SC	No	No	No	E	E	No	No
Blackhawk		No	No	No	E	E	No	No

P=poor control, F=fair control, G=good control, E=excellent control, No=not labeled or no activity expected.

<sup>1</sup>There are other insecticides and other formulations which have federal registration for use on peanuts.

<sup>2</sup>Use of these insecticides may allow rapid build-up of spider mites. Use with caution during extended periods of dry weather.



## Cotton

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### Thrips

Thrips affect cotton in the early stages of development. These tiny, spindle-shaped insects complete several generations per season under favorable conditions and feed primarily by puncturing and rasping the outer cells of the young leaves and buds. Injury results in ragged looking plants with crinkled or “possum-eared” leaves. The injury associated with thrips feeding can stunt growth resulting in fruiting at higher positions and delayed maturity. Injury is most severe if young cotton is subjected to adverse growing conditions or when alternate thrips hosts such as small grains dry down prematurely, forcing large numbers of thrips to seek other hosts. Adverse growing conditions during the early stages of cotton development may reduce the uptake of systemic insecticides, therefore early inspection of the crop is important. Our research indicates that cotton varieties with ThryvOn Technology, which received full commercialization in 2023, do not require in-furrow or foliar insecticide applications for thrips control.

**Orthene 97 in furrow** - Orthene 97 can be dribbled or sprayed in furrow during the planting operation. Orthene provides good thrips control for up to five weeks if applied at 12-16 oz of product per acre. Applications are usually made at 3-5 gallons per acre and are compatible with several liquid fungicides.

Insecticidal seed treatments of imidacloprid and thiamethoxam will provide good thrips control, but may require a foliar application when plants grow slowly.

There is no formal threshold for thrips based on insect numbers or plant injury. Treatment is thought to be justified if the following conditions are met: 1) thrips injury is common, 2) 10% or more plants show extensive bud damage, 3) immature thrips can be easily found, and 4) plant growth is poor.

**Table 4.57 - Recommended Insecticides for Thrips Control**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
In-furrow or seed	acephate (Orthene 97)	8.0-16.0 oz	21	Apply as a liquid into the seed furrow in 3-5 gal of water/A with a system that ensures good seed coverage. Do not feed treated forage or hay to livestock or allow animals to graze treated areas.
	aldicarb (AgLogic 15G, AgLogic 15GG)	3.5-5.0 lb	90	Do not feed cotton forage to livestock or allow livestock to graze in treated area. Immediately deep-disk any spills at row ends or elsewhere to ensure the granules are covered with a layer of soil. Application rate may be reduced by 1/2 if seeds and granules are hill dropped.
	imidacloprid (Admire Pro)	7.4-9.2 oz	—	Apply as an in-furrow spray during planting directed on or below seed. Do not graze treated fields after any application of Admire Pro.
	imidacloprid (Gaucho Grande, Aeris)	0.375 mg ai/ seed	—	—
	phorate (Thimet 20G)	6.0-9.0 oz/1,000 row ft	—	<b>RESTRICTED USE.</b> Do not graze or feed treated hay or forage to livestock.

**Table 4.57 - Recommended Insecticides for Thrips Control (cont.)**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
In-furrow or seed (cont.)	thiamethoxam (Cruiser 5FS, Avicta CP)	0.30-0.375 mg ai/seed	—	—
Foliar	acephate (Orthene 97)	2.5-3.0 oz	21	—
	spinetoram (Radiant SC)	4.25-8.0 oz	28	2 (ee) Recommendation lists 1.5-3.0 oz for early season suppression. Use with an adjuvant to improve control.

## Plant Bugs

**Prebloom:** Prior to bloom, tarnished plant bugs, or lygus bugs, injure cotton by feeding on tender terminals and small squares causing squares to turn black and abort. Excessive square loss can reduce yields and slow plant maturity. Plant bugs are found across Virginia's entire cotton growing region throughout the pre-bloom and bloom period (late May-August). Fields adjacent to corn, weed fields, and other sources of plant bugs in eastern counties may be at relatively higher risk of plant bug injury. Frequent scouting during pre-bloom and flowering is advised. Lygus adults can rapidly infest fields and re-infest following treatment. Multiple applications may be required. Rotation between modes of action is recommended. The best way to determine the need for pre-bloom plant bug control is to assess square retention rates (percent missing squares) in addition to scouting for insects. Treatment should be considered if square retention drops below 80% (see threshold table below) and plant bugs are active.

**After blooming:** Once blooming begins, plant bugs continue feeding on smaller squares and blooms, both of which can cause 'dirty blooms' (white blooms with brown pollen anthers or brown-streaked petals). The presence of dirty blooms indicates that plant bugs are, or have very recently been, active. Levels at or above 15% dirty bloom indicate a large and active plant bug population and the need for sampling of bolls for injury (see threshold table below). Do not spray insecticides based on dirty blooms alone. Neonicotinoid insecticides (i.e., products containing imidacloprid, thiamethoxam, or clothianidin) are less effective during bloom and are prohibited because of pollinator guidelines. Read and follow label instructions with all pesticide applications. Most insecticides labeled for plant bug control are toxic to bees and beneficial predators. Only spray insecticides when necessary. Pyrethroids lose efficacy over the season and should not be used alone past the second week of bloom.

**Boll injury:** Once bolls are formed, plant bugs prefer feeding on small bolls up to 3 weeks old. Injury to bolls can range from warts or calluses on the insides of boll walls, to small areas of stain lint, to deformed and rotting fruit that is due to direct feeding on seed. This is identical to injury caused by stink bugs.

**Table 4.58 - Sampling for Plant Bugs and Thresholds in Cotton**

Pre-bloom	below 80% square retention and plant bugs active
During bloom	15% injured bolls or dirty blooms indicates the presence of an active population 8 plant bugs per 100 sweeps (use sweep net thresholds during the first two weeks of bloom only) or 2.5 or more plant bugs per drop cloth sample (use drop cloth thresholds following the second week of bloom) indicate a large, active population

**Table 4.59 - Recommended Insecticides for Plant Bug Control**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	acephate (Orthene 97)	4.0-16.0 oz	21	
	acetamiprid (Assail 70WP)	1.1-2.3 oz	28	Do not apply to blooming cotton.
	beta-cyfluthrin (Baythroid XL)	1.6-2.6 oz	0	<b>RESTRICTED USE.</b> May not provide adequate control in blooming cotton.
	bifenthrin (Brigade 2EC)	2.6-6.4 oz	14	<b>RESTRICTED USE.</b> May not provide adequate control in blooming cotton.
	bifenthrin + chlorantraniliprole (Elevest)	4.8-9.6 oz	21	<b>RESTRICTED USE.</b> This product is used to target both plant bugs and caterpillar pests.
	dicrotophos + bifenthrin (Bidrin XP11)	8.0-10.5, 12.8* oz	30	<b>RESTRICTED USE.</b> Do not graze livestock, cut treated crops for feed, or feed gin trash. Do not apply as a ULV application. *Use higher rate with heavy infestations.
	dinotefuran (Venom 20SG)	1.0-3.0 oz	14	
	esfenvalerate (Asana XL 0.66EC)	5.8-9.6 oz	21	<b>RESTRICTED USE.</b> May not provide adequate control in blooming cotton.
	imidacloprid (Admire Pro)	0.9-1.7 oz	14	Do not apply to blooming cotton.
	lambda-cyhalothrin (Warrior II)	1.28-1.92 oz	21	<b>RESTRICTED USE.</b> May not provide adequate control in blooming cotton.
	lambda-cyhalothrin + thiamethoxam (Endigo ZC)	4.5-5.5 oz	21	<b>RESTRICTED USE.</b> Do not graze livestock in treated areas. Do not apply to blooming cotton. .
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	6.5-12.5 oz	21	<b>RESTRICTED USE.</b> Do not graze livestock in treated areas. May not provide adequate control in blooming cotton. This product is used to target both plant bugs and caterpillar pests.
	methomyl (Lannate LV)	1.5 pt/A (early season), 1.5-2.25 pt/A (late season)	15	<b>RESTRICTED USE.</b> Refer to label for rates to conserve natural enemies.
	(Lannate SP)	0.5 lb/A (early season), 0.5-0.75 lb/A (late season)	15	
	novaluron (Diamond)	6.0-12.0 oz	30	Targets immature stages. Use with an adult knockdown product such as acephate or a pyrethroid.
oxamyl (Vydate C-LV)	4.25-17.0 oz	14	<b>RESTRICTED USE.</b> Follow label directions on number of applications and rates.	

**Table 4.59 - Recommended Insecticides for Plant Bug Control (cont.)**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar (cont.)	sulfoxaflor (Transform WG)	1.5-2.25 oz	14	
	thiamethoxam (Centric 40WG)	1.25-2.5 oz	21	Do not use if squares, blooms, or bolls present..
	zeta-cypermethrin (Mustang Maxx)	2.64-3.6 oz	14	<b>RESTRICTED USE.</b>

## Tobacco Budworm/Cotton Bollworm

Bollworms (AKA corn earworms) occur primarily on field corn during their first two generations. Third generation moths usually emerge in large numbers from mid-July to early August when corn is drying and fly to more attractive blooming cotton.

Regular weekly scouting for the bollworm should begin in early to mid-June. Weekly scouting is adequate until egg laying or light-trap catches increase. Fields should then be scouted twice a week, with the emphasis placed upon finding eggs, until insecticide treatments begin. After that, a 4- to 7-day scouting schedule will usually suffice. Once the egg threshold has been met and treatments made, the primary focus of scouting shifts toward finding small bollworms feeding on squares and bolls, including those under bloom tags. Pyrethroids offer poor to moderate control of corn earworm in Virginia and poor to no control of tobacco budworm (at this time, tobacco budworm is controlled by Bt toxins expressed in two- and three-gene transgenic cotton). If you decide to spray a pyrethroid, use the highest labeled rate and do not expect good control of heavy infestations or large worms.

Tobacco budworm adults are not readily attracted to black light traps and sometimes begin laying eggs on cotton prior to the time at which the bollworm egg threshold has been met; occasional fields may reach a 3 percent larval threshold prior to bollworm treatment initiation. Under these circumstances, tobacco budworm pheromone trap deployment and correct sight identification of adult tobacco budworms can assist in recognition of this situation. Unlike bollworm, tobacco budworm are controlled by currently available Bt cotton varieties. It is not possible to visually distinguish budworm and bollworm eggs. Conservatively, base treatment decisions on the assumption that all eggs found in cotton are bollworm.

After the upper bolls that will be harvested have become difficult to cut with a pocket knife (approximately three weeks after bloom), they are normally safe from bollworm attack. Bollworm scouting can normally be stopped at that time—usually in late August to early September.

**Table 4.60 - Bollworm and Tobacco Budworm Thresholds in Cotton**

Cotton Type	Threshold	Remarks
<i>Conventional Cotton</i>		
Prebloom	8 bollworms/100 terminals or 6 bollworms/100 squares	Limiting this treatment to one well-timed pyrethroid application is strongly recommended.
Egg	10+ eggs/100 terminals or 2 eggs/100 fruiting forms	After the onset of the major (third generation) bollworm moth flight.
Post-bloom larval	3 live worms/100 terminals, or 3 percent fresh damage to squares, blooms, or bolls	Usually after the egg threshold has been employed; also used after blooming begins and before major bollworm flight, particularly if tobacco budworms are present.
<i>Two-gene cotton (Widestrike, Bollgard II, and TwinLink varieties)</i>		



**Table 4.60 - Bollworm and Tobacco Budworm Thresholds in Cotton (cont.)**

Cotton Type	Threshold	Remarks
Egg	25 eggs/100 terminals or leaves	Sample both terminals and leaves. Check leaves at multiple levels throughout the canopy. If applying product at egg threshold, use Prevathon.
Larval	3 second-stage (1/8 inch or larger) bollworms/100 squares or bolls or 2 second-stage bollworms on 2 consecutive scouting trips or 1 second-stage bollworm on 3 consecutive scouting trips	Use against the major bollworm generation. Pay particular attention to bollworms in or under yellow, pink, or dried blooms, but only sample in proportion to their occurrence. No product will provide good control of larvae in bloom tags or bolls.
Damage	3 to 6 percent significantly damaged squares (would cause squares to abort) or bolls	
<i>Three-gene cotton (Widestrike 3, Bollgard III, and TwinLink Plus varieties)</i>		
Larval	3 second-stage (1/8 inch or larger) bollworms/100 squares or bolls or 2 second-stage bollworms on 2 consecutive scouting trips or 1 second-stage bollworm on 3 consecutive scouting trips	Use against the major bollworm generation. Pay particular attention to bollworms in or under yellow, pink, or dried blooms, but only sample in proportion to their occurrence. No product will provide good control of larvae in bloom tags or bolls.

**Table 4.61 - Recommended Insecticides for Bollworm Control**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar (pyrethroids)	beta-cyfluthrin (Baythroid XL)	1.6 <sup>1</sup> -2.6 <sup>2</sup> oz	0	<b>RESTRICTED USE.</b>
	bifenthrin (Brigade 2EC)	2.6 <sup>1</sup> -6.4 <sup>2</sup> oz	14	<b>RESTRICTED USE.</b>
	bifenthrin + chlorantraniliprole (Elevest)	4.8-9.6 oz	21	<b>RESTRICTED USE.</b>
	esfenvalerate (Asana XL 0.66EC)	5.8 <sup>1</sup> -9.6 <sup>2</sup> oz	21	<b>RESTRICTED USE.</b>
	fenpropathrin (Danitol 2.4EC)	10.6 <sup>1</sup> -16.0 <sup>2</sup> oz	21	<b>RESTRICTED USE.</b>
	lambda-cyhalothrin (Warrior II)	1.6 <sup>1</sup> -2.56 <sup>2</sup> oz	21	<b>RESTRICTED USE.</b>
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	6.5-12.5 oz	21	<b>RESTRICTED USE.</b> Do not graze livestock in treated areas.
	dicrotophos + bifenthrin (Bidrin XP II)	8.0-10.5, 12.8* oz	30	<b>RESTRICTED USE.</b> Do not graze livestock, cut treated crops for feed, or feed gin trash. Do not apply as a ULV application. *Use higher rate with heavy infestations.
	zeta-cypermethrin (Mustang Maxx)	2.64 <sup>1</sup> -3.6 <sup>2</sup> oz	14	<b>RESTRICTED USE.</b>

<sup>1</sup>Standard rate

<sup>2</sup>High rate

**Table 4.61 - Recommended Insecticides for Bollworm Control (cont.)**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar (others)	<i>Bacillus thuringiensis</i> (DiPel ES)	1.0-6.0 pt	0	For pyrethroid resistant corn earworms (bollworms) when tank mixed with a pyrethroid at a labeled use rate.
	indoxacarb (Steward EC)	11.3 oz	14	
	methomyl (Lannate LV)	1.5 pt/A (early season), 1.5-2.25 pt/A (late season)	15	<b>RESTRICTED USE.</b> Refer to label for rates to conserve natural enemies.
	(Lannate SP)	0.5 lb/A (early season), 0.5-0.75 lb/A (late season)	15	
	methoxyfenozide + spinetoram (Intrepid Edge)	6.0-8.0 oz	28	
	rynaxypyr (Coragen)	3.5-7.5 oz	21	See label for instructions for non-Bt and Bt cotton varieties.
	spinetoram (Radiant SC) (prebloom)	2.8-8.0 oz	28	
	(postbloom)	4.25-8.0 oz		
	spinosyn (Blackhawk)	1.6-3.2 oz	28	For second-generation tobacco budworms, 1.6 oz is adequate; for post-bloom bollworms, use the 3.2 oz rate.
	chlorantraniliprole (Prevathon)	14.0-27.0 oz	21	See label for instructions for non-Bt and Bt cotton varieties.
	(Vantacor)	1.2-2.5 oz	21	See label for instructions for non-Bt and Bt cotton varieties.

<sup>1</sup>Standard rate<sup>2</sup>High rate

## European Corn Borer

European corn borer (ECB) is controlled by two- and three-gene Bt cotton varieties. The following recommendations are for conventional cotton only. Larvae damage cotton by feeding on large bolls from early August through mid-September. In rank or late-maturing cotton, this damage can be significant. An earlier tunneling type of damage may occur within stems and leaf petioles, usually in mid-July through late August. Although this damage looks serious, with wilting and eventual death of the tissue above the feeding site, it causes no known economic loss. The major moth flight for the ECB often occurs a few days to three weeks later than the major bollworm flight. The female moths lay egg masses that contain 15-75 eggs each. These small, flat, scale-like masses are deposited on the underside of cotton leaves deep within the canopy. At first, early instars feed within the leaf petioles and stems, but they begin to enter and feed upon large bolls, sometimes within 48 hours, particularly after mid-August. Although the caterpillars of this species generally do not feed as extensively within the bolls as do bollworms, most bolls are destroyed. European corn borer is controlled by currently available Bt cotton varieties.

Controlling ECB damage in conventional cotton presents an unusual problem. The flat egg masses are almost impossible to find, even by the trained scouts searching heavily infested fields. By the time the larvae are found feeding on or within bolls, insecticide treatments are usually ineffective. Thus scouting for this pest benefits the producer little during the present year. However, scouting to detect the caterpillars is advised. If small larvae are present (3 percent or more), treatment may be prescribed if an active flight is confirmed. This situation may indicate a late, rank cotton crop that should be avoided in the future.

No control threshold has been developed since finding the egg masses is virtually impossible, and live caterpillars are spotted too late to achieve effective control. Growers must depend on another observation as a trigger for directing insecticide against the pest. Fortunately, because egg laying of the corn earworm usually occurs somewhat earlier than the ECB flight, employing the egg threshold for bollworm control usually works well for ECB if treatments are extended into the ECB infestation period. An insecticide should be selected that is effective against both insects. If the major part of the ECB flight occurs after the bollworm flight has subsided and spraying has been completed, fields can be particularly susceptible. Under this condition, 3-6 total applications may be required for adequate suppression. This approach is recommended only where late rank growth points toward a high probability of ECB damage. Finding moths of this species in local light or pheromone traps, or flushing the adults from around or within cotton fields can help confirm the need for this extended treatment.

**Table 4.62 - Recommended Insecticides for European Corn Borer Control**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	beta-cyfluthrin (Baythroid XL)	1.6-2.6 oz	0	<b>RESTRICTED USE.</b>
	bifenthrin (Brigade 2EC)	1.3-6.4 oz	14	<b>RESTRICTED USE.</b>
	dicrotophos + bifenthrin (Bidrin XPll)	8.0-10.5, 12.8* oz	30	<b>RESTRICTED USE.</b> Do not graze livestock, cut treated crops for feed, or feed gin trash. Do not apply as a ULV application. *Use higher rate with heavy infestations.
	lambda-cyhalothrin (Warrior II)	1.6-2.56 oz	21	<b>RESTRICTED USE.</b>
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	6.5-12.5 oz	21	<b>RESTRICTED USE.</b> Do not graze livestock in treated areas.
	spinetoram (Radiant SC)	2.8-8.0 oz	28	
	zeta-cypermethrin (Mustang Maxx)	2.64-3.6 oz	14	<b>RESTRICTED USE.</b>

## Stink Bugs

Stink bugs typically begin invading cotton fields in mid-July and build to damaging levels in August. Stink bugs injure cotton by puncturing the carpal walls of bolls and feeding on the soft developing seeds. If bolls are small when feeding occurs, the boll will dry up, turn brown and either remain on the plant or be shed. Bollrot pathogens are sometimes introduced when feeding is concentrated on medium and larger bolls, resulting in portions of the boll being destroyed, hard-lock, and lower grades. External feeding damage appears as small round purplish depressions about the size of a pencil point. The feeding sites are slightly larger but closely resemble the spots that naturally appear on maturing bolls. Stink bug feeding sites can be confirmed by slicing the bolls open under the depressions. The damaged bolls will have a brown stain (bollrot organisms) in the seed area under these spots.

Stink bugs often occur in a clumped distribution within a cotton field; therefore, at least 10 samples should be taken throughout a field to determine if a problem exists. Both sweep nets and shake cloths can be used to sample for stink bugs, but our research showed that of the two, shake cloths tend to do a better job. A sweep net sample should consist of 25 hard sweeps using a pendulum-like motion with enough speed and force to end up with some leaves and small bolls in the net. An average of one stink bug per 25 sweeps could indicate a problem. A shake cloth sample should consist of placing a 3-foot long cloth on the ground between the rows, bending the bordering plants on either side (first one side, then the other) and vigorously shaking those plants to dislodge any insects. An average of one stink bug per 6 row feet (one 3-foot long shake cloth sample, both sides of the cloth) could indicate a problem.

## 4-84 Insect Control in Field Crops: Cotton

Research in the southeast has resulted in a dynamic threshold based on percent of bolls injured by stink bug feeding, that changes with week after first bloom (see below). Stink bug and plant bug injury is indistinguishable. Scouting using a sweep net or beat cloth should be conducted in addition to internal boll injury to determine which species is causing the problem.

**Table 4.63 - Sampling for Stink Bugs and Thresholds in Cotton**

Indicates presence	an average of 1 per 6 row feet using a 3-foot shake cloth
	an average of 1 per 25 sweeps using a 15-inch diameter sweep net
Boll damage	Week of bloom 1 = 50% internal boll damage; week 2 = 30%; weeks 3, 4 and 5 = 10%; week 6 = 20%; week 7 = 30%; week 8 = 50%.

**Table 4.64 - Recommended Insecticides for Stink Bug Control**

Treatment	Insecticide (Formulation)	Amount per acre product	Time limits: days before harvest	Remarks
Foliar	acephate (Orthene 97)	12.0 oz	21	Do not feed treated forage or hay to livestock or allow animals to graze treated areas. For brown and green stinkbugs.
	dicrotophos + bifenthrin (Bidrin XP11)	8.0-10.5, 12.8* oz	30	<b>RESTRICTED USE.</b> Do not graze livestock, cut treated crops for feed, or feed gin trash. Do not apply as a ULV application. *Use higher rate with heavy infestations.
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	6.5-12.5 oz	21	<b>RESTRICTED USE.</b> Do not graze livestock in treated areas.
	chlorantraniliprole + bifenthrin (Elevest)	4.8-9.6 oz	21	<b>RESTRICTED USE.</b> This product is used to target both stink bugs and caterpillar pests.
	pyrethroids (see product labels)			<b>RESTRICTED USE.</b>

## Aphids

A number of beneficial insects and fungal diseases can hold aphid numbers below economic threshold levels. By limiting early season insecticide applications, the grower is allowing beneficial insect populations to build, decreasing the chances of developing resistant aphid populations (observed in North Carolina and Virginia), and possibly reducing or eliminating the need for insecticide applications later in the season. An aphid rating level of four or more just before boll opening, plus the presence of honeydew, is probably a good indicator of the need to treat. Aphid control with insecticides should be attempted only as a last resort, particularly in early season (before major bollworm moth flight).

**Table 4.65 - Aphid Rating Scale**

0	No aphids
1	Occasional plants with low numbers of aphids
2	Plants with low numbers common; heavily infested plants rare; honeydew visible occasionally
3	Most plants with some aphids; occasional plants heavily infested; honeydew easily visible in most areas of the field
4	Heavily infested plants common; aphids clumped on upper leaves
5	Many heavily infested plants

**Table 4.66 - Recommended Insecticides for Aphid Control**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	acetamiprid (Assail 70WP)	0.6-1.1 oz	28	Do not use on blooming cotton.
	bifenthrin (Brigade 2EC)	2.6-6.4 oz	14	<b>RESTRICTED USE.</b>
	dicrotophos (Bidrin 8)	1.6-3.2 oz (early season) 4.0-8.0 oz (late season)	30	<b>RESTRICTED USE.</b> Suppression only.
	flupyradifurone (Sivanto 200 SL)	7.0-10.5 oz	14	
	imidacloprid (Admire Pro)	0.9-1.7 oz	14	Do not use on blooming cotton.
	thiamethoxam (Centric 40WG)	1.25-2.5 oz	21	Do not use on blooming cotton.

## Spider Mites

Spider mites can occur during any time of the season, but are favored by dry weather and/or the removal of alternative hosts (e.g., corn). Mite damage first appears as a slight yellowing of the leaves, which later changes to a purplish or bronze color and is usually associated with webbing. Damage occurs especially in spots or on field edges but widespread defoliation is not uncommon if favorable conditions persist.

Spider mites can be checked while scouting for other insect pests. Active mite populations should be confirmed before applications are made. Delaying treatment should also be considered if rainy, humid conditions are predicted in the near future. Rainy, humid conditions favor a fungus that preys upon mites and may greatly reduce mite numbers.

**Table 4.67 - Recommended Miticides for Spider Mite Control**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	etoxazole (Zeal)	0.66-1.0 oz	28	
	fenpropathrin (Danitol 2.4EC)	10.6-16.0 oz	21	<b>RESTRICTED USE.</b> Populations will rebound after application if dry weather persists.
	propargite (Comite 6.55EC)	1.0-2.0 pt	50	Apply only before bolls open.
	spiromesifen (Oberon 4SC)	3.0 oz (early season) 4.0-8.0 oz (mid-late season)	30	

## Fall Armyworms

Fall armyworm is controlled by two- and three-gene Bt cotton varieties. The following recommendations are for conventional cotton only. The presence of fall armyworms (FAW) and their damage is recorded as part of bollworm scouting. Additional samples are unnecessary. FAW migrate into Virginia from the south. FAW prefer blooms and bolls of all sizes. These caterpillars can be extremely damaging if present in moderate numbers and can become established late in the season. They can feed on mature bolls normally resistant to bollworm penetration. Because FAW are not always controlled effectively by the same insecticides as bollworms, it is very important that they be identified correctly. Also, because fall armyworms are difficult to control with insecticides, treatments are best applied at an early boll bract feeding stage.

**Table 4.68 - Recommended Insecticides for Fall Armyworm Control**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	bifenthrin + chlorantraniliprole (Elevest)	5.6-9.6 oz	21	<b>RESTRICTED USE.</b>
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	6.5-12.5 oz	21	<b>RESTRICTED USE.</b> Do not graze livestock in treated areas.
	dicrotophos + bifenthrin (Bidrin XP11)	8.0-10.5 or 12.8 oz	30	<b>RESTRICTED USE.</b> Do not graze livestock, cut treated crops for feed, or feed gin trash. Do not apply as a ULV application. *Use higher rate with heavy infestations.
	indoxacarb (Steward EC)	9.2-11.3 oz	14	
	methomyl (Lannate LV)	1.5 pt/A (early season), 1.5-2.25 pt/A (late season)	15	<b>RESTRICTED USE.</b>
	(Lannate SP)	0.5 lb/A (early season), 0.5-0.75 lb/A (late season)	15	
	methoxyfenozide (Intrepid 2F)	4.0-10.0 oz	14	Suppression only.
	methoxyfenozide + spinetoram (Intrepide Edge)	6.0-8.0 oz	28	
	rynaxypyr (Coragen)	3.5-7.5 oz	21	
	spinetoram (Radiant SC)	4.25-8.0 oz	28	
	spinosyn (Blackhawk)	2.4-3.2 oz	28	
	chlorantraniliprole (Prevathon)	14.0-27.0 oz	21	
	(Vantacor)	1.2-2.5 oz	21	

**Table 4.69 - Recommended Insecticides for Beet Armyworm Control**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
	dicrotophos + bifenthrin (Bidrin XP11)	8.0-10.5, 12.8* oz	30	<b>RESTRICTED USE.</b> Do not graze livestock, cut treated crops for feed, or feed gin trash. Do not apply as a ULV application. *Use higher rate with heavy infestations.
	indoxacarb (Steward EC)	9.2-11.3 oz	14	
	methoxyfenozide (Intrepid 2F)	4.0-10.0 oz	14	
	methoxyfenozide + spinetoram (Intrepid Edge)	4.0-8.0 oz	28	
	rynaxypyr (Coragen)	3.5-7.5 oz	21	
	spinetoram (Radiant SC)	4.25-8.0 oz	28	
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	6.5-12.5 oz	21	<b>RESTRICTED USE.</b> Do not graze livestock in treated areas. For control of 1 <sup>st</sup> and 2 <sup>nd</sup> instar only.
	spinosyn (Blackhawk)	2.4-3.2 oz	28	
	chlorantraniliprole (Prevathon)	14.0-27.0 oz	21	
	(Vantacor)	1.2-2.5 oz	21	
	chlorantraniliprole + bifenthrin (Elevest)	5.6-9.6 oz	21	<b>RESTRICTED USE.</b>

**Table 4.70 - Recommended Insecticides for Cutworm Control**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	acephate (Orthene 97)	12.0 oz	21	Control is most effective when ground application is made in the evenings and sprays are directed toward the base and lower portion of plants.
	beta-cyfluthrin (Baythroid XL)	0.8-1.6 oz	0	<b>RESTRICTED USE.</b>
	bifenthrin (Brigade 2EC)	2.6-6.4 oz	14	<b>RESTRICTED USE.</b>
	bifenthrin + chlorantraniliprole (Elevest)	4.8-9.6 oz	21	<b>RESTRICTED USE.</b>
	dicrotophos + bifenthrin (Bidrin XP11)	8.0-10.5, 12.8* oz	30	<b>RESTRICTED USE.</b> Do not graze livestock, cut treated crops for feed, or feed gin trash. Do not apply as a ULV application. *Use higher rate with heavy infestations.

**Table 4.70 - Recommended Insecticides for Cutworm Control (cont.)**

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar (cont.)	esfenvalerate (Asana XL 0.66EC)	5.8-9.6 oz	21	<b>RESTRICTED USE.</b>
	fenpropathrin (Danitol 2.4EC)	10.6-16.0 oz	21	<b>RESTRICTED USE.</b>
	lambda-cyhalothrin (Warrior II)	0.96-1.28 oz	21	<b>RESTRICTED USE.</b>
	zeta-cypermethrin (Mustang Maxx)	1.28-1.92 oz	14	<b>RESTRICTED USE.</b>

## Beneficial Insects

About a dozen beneficial insects are common in Virginia cotton. Ambush bugs, big-eyed bugs, minute pirate bugs, green lacewings, two species of ladybird beetles, and several types of spiders are examples. They are of two types: 1) predators that prey upon an insect pest, or 2) parasites that live within the host insect. These insects, particularly the predators, reduce the number of eggs and larvae of bollworms, caterpillars and aphids. Because these allies lessen the impact of pest insects, common sense dictates that producers use them as a management tool. Their presence often means that growers can delay and, on occasion, eliminate some insecticide applications. While many people would hesitate to call fire ants beneficial, they are excellent predators of caterpillars and bollworm eggs.

Many complex factors are involved in determining just how many of each beneficial insect species are needed to influence a given level of pests. Therefore, it is usually not possible to assess the value of these insects except in a very general way. If relatively high numbers of beneficial insects are eating a large portion of aphids or bollworm eggs and larvae, the treatment threshold will be reached later than would otherwise be the case, reducing the number of insecticide applications needed. However, the rapid increase in pest populations, the third generation of bollworms, will often overwhelm the beneficial population and applications become necessary. The careful observation of sound economic thresholds offers the producer the best odds of balancing beneficial insect numbers against damaging insects.