

# 2020 Soybean Insect Control Recommendations

## Introduction

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

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

## Scouting Procedures

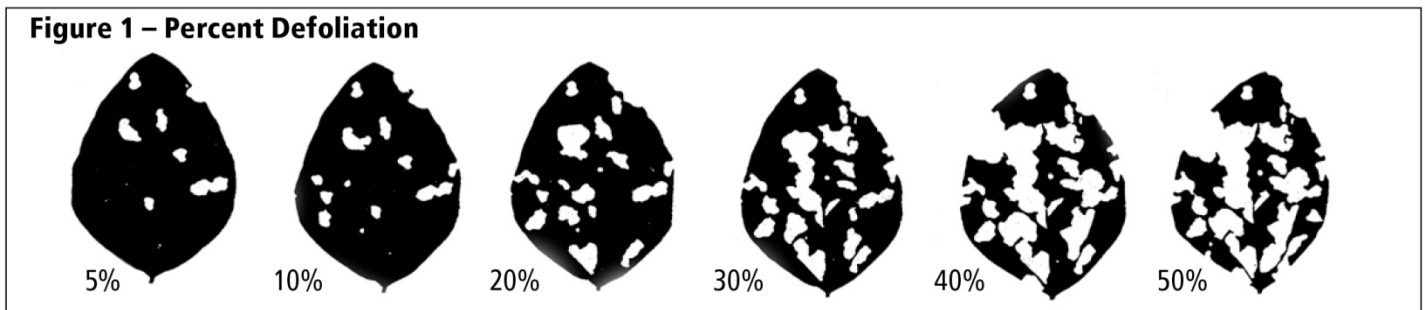
**General Scouting Procedures:** A good sampling plan is to take 25 sweeps at 4 locations in average sized fields (about 50 acres). Increase sampling points proportionately with the acreage in a field. Make sure sample points are scattered over the entire field.

**Seedling/Stem Feeding:** Check seedlings very closely until the plants are about 12 inches tall. The stems become woody and severe damage from seedling pests becomes less likely at this time. Look for insects that may be on the plant (threecornered alfalfa hopper) or in the soil around the base of the plants (lesser corn stalk borer, cutworms). Evaluate stand loss (percentage of dead or dying plants) and try to determine if future stand loss is probable (insects easily found and actively damaging plants).

**Foliage Feeders:** Determine what insects are eating the foliage and estimate percent defoliation. Use a sweep net or a drop cloth (shake sheet) to sample for insect pests. At each sample point, estimate percent foliage loss so that an average can be calculated for the field.

**Pod-Feeders:** After full bloom, when pods are forming, look closely for any pod-feeding caterpillars (corn earworms and fall armyworms) and stink bugs which are caught in a sweep net.

**Representation of Percent Defoliation:** Inexperienced scouts often overestimate percent defoliation. Use the image below to help calibrate your estimates, but ratings should be for the entire canopy, not just upper canopy leaves.



## Expected Occurrence of Insect Pests in Soybean

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

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

## Insecticide Seed Treatments

Insecticide seed treatments such as thiamethoxam (e.g., Cruiser), imidacloprid (e.g., Gaucho, Acceleron I), and clothianidin (e.g., NipsIt Inside) are available from seed companies or local distributors. Seed treatments will help control some seed and seedling pests such as thrips, bean leaf beetle, grape colaspis, threecornered alfalfa hopper, wireworms and white grubs. Data indicates that insecticide seed treatments provide an average yield increase of 1-2 bushels per acre in Tennessee. Insecticide seed treatments are recommended when cover crops are planted and persist in fields within 3 to 4 weeks of planting, particularly if the cover crop includes a legume species such as vetch or winter peas.

| Pest  | When to Treat  |
|---|--|
| Threecornered Alfalfa Hopper  | Treat if 10 percent of young plants (up to 10-12 inches) are infested with adults or nymphs. Bend small plants over to check for girdling and consider treatment if 50 percent or more of plants are girdled. Treatment is not generally recommended for plants greater than 12 inches tall.   |
| Defoliating Pests (bean leaf beetles, green cloverworm, blister beetles, loopers, grasshoppers, Japanese beetles, etc.) | Treat at 30 percent defoliation until bloom (R1), 20 percent from bloom to full seed (R1-R6), and 30 percent after R6 to R6 plus 7-10 days.<br><br><u>Alternatives to defoliation thresholds during pod filling (R1-R6):</u><br>Bean leaf beetle – 50 beetles per 25 sweeps *<br>Green cloverworm – 38 larvae per 25 sweeps *<br>Loopers – 19 larvae per 25 sweeps * |
| Stink Bugs  | From beginning bloom (R1) to full seed (R6), treat when an average of 9 or more stink bugs is found per 25 sweeps (or 1 stink bug is found per foot of row). From R6 to R7, treat when an average of 18 or more stink bugs is found per 25 sweeps. *   |
| Corn Earworm  | See tables below for treatment threshold based on sweep net sampling, or consider treatment once blooming has begun if an average of 1 or more larvae is found per foot of row.  |
| Fall Armyworm   | Once blooming has begun, treat when an average of 9 or more larvae is found per 25 sweeps (or 1 or more larvae is found per foot of row). Fall armyworm may also feed on foliage, and severe infestations may originate on weedy grasses. Treatment can be based on the percent defoliation thresholds above under these circumstances.                              |

| Pest          | When to Treat  |
|---------------|--|
| Soybean Aphid | Treat when an average of 250 aphids or more is found per plant from early bloom (R1) until early pod fill (R5). Treatment after R5 is less likely to increase yield.                                 |
| Kudzu Bug     | Treat between emergence and R1 when 5 or more kudzu bugs are found per plant. From R1 to R7, treat when an average of 1 or more <u>immature</u> kudzu bug is present per sweep (25 per 25 sweeps). * |

## Premixed Insecticide Products

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

| Trade Name (Insecticides)                               | Amount Product per Acre | Primary Target Pests (see label for other pests that may be controlled)              |
|---|-------------------------|--|
| Besiege (chlorantraniliprole, $\lambda$ -cyhalothrin)   | 5 - 10 oz               | Caterpillars, stink bugs, threecornered alfalfa hopper, kudzu bug                    |
| Brigadier (imidacloprid, bifenthrin)                    | 4 - 6.1 oz              | Corn earworm, green cloverworm, stink bugs, kudzu bug                                |
| Cobalt Advanced (chlorpyrifos, $\gamma$ -cyhalothrin)   | 22 - 38 oz              | Stink bugs, corn earworm, green cloverworm, threecornered alfalfa hopper             |
| Double Take (diflubenzuron, $\lambda$ -cyhalothrin)     | 2 - 4 oz                | Green cloverworm, stink bugs, threecornered alfalfa hoppers, kudzu bug, grasshoppers |
| Endigo ZC (thiamethoxam, $\lambda$ -cyhalothrin)        | 3.5 - 4.5 oz            | Stink bugs, corn earworm, green cloverworm, threecornered alfalfa hopper, kudzu bug  |
| Hero (bifenthrin, Z-cypermethrin)                       | 4 - 10.3 oz             | Stink bugs, corn earworm, green cloverworm, threecornered alfalfa hopper, kudzu bug  |
| Intrepid Edge (methoxyfenozide, spinetoram)             | 4 - 6.4 oz              | Most caterpillar pests   |
| Justice (acetamiprid, bifenthrin)                       | 3 - 5 oz                | Bean leaf beetle, aphids, armyworms, kudzu bugs                                      |
| Leverage 360 (imidacloprid, $\beta$ -cyfluthrin)        | 2.8 oz                  | Stink bugs, corn earworm, green cloverworm, threecornered alfalfa hopper             |
| Stallion (chlorpyrifos, Z-cypermethrin)                 | 9.25 - 11.75 oz         | Stink bugs, corn earworm, green cloverworm, threecornered alfalfa hopper             |
| Triple Crown (Z-cypermethrin, bifenthrin, imidacloprid) | 3.5 - 4.8 oz            | Stink bugs, corn earworm, green cloverworm, threecornered alfalfa hopper, kudzu bug  |

## Fall Armyworm, Beet Armyworm and Yellowstriped Armyworm

*Spodoptera* spp. including the fall, beet and yellowstriped armyworm are often found in soybean, although they only occasionally cause economic damage. All three species feed on foliage. The fall and beet armyworm, in particular, may also feed on pods. Armyworms lay their eggs in a mass that is covered with tan (fall and yellowstriped) or white (beet) scales from the moth's body. The caterpillars (larvae) vary in color but generally lack obvious setae (hairs) on the body. All species are approximately 1.5 inches long when fully grown and have 4 pairs of prolegs.

Fall armyworm is a multicolored, striped caterpillar. They often have a prominent, light-colored inverted "Y" on a dark-colored head, but the head of this species is often lighter in color when it occurs on soybean, in pastures, or on weedy grasses. Armyworms may feed on leaves, stems and pods. Economically damaging infestations are most common in late maturing fields. Serious damage is sometimes seen when larvae occur on weedy grasses within the field and move onto soybean when the grasses are consumed or removed with an herbicide application. Infestations may also be worse along field edges where grasses are present.

Beet armyworm larvae are generally green in color, and the small larvae feed in clusters of 10-30 individuals, often skeletonizing the undersides of leaves. Larger larvae are less aggregated and may feed on leaves, flowers and pods. They have a small black dot on either side of the body above the second pair of true legs. Beet armyworm larvae are often found on plants near Palmer pigweeds, a preferred host of this species. Thus, infestations may be worse in fields where this weed is common. Beet armyworm infestations can be worsened by the previous use of insecticides that disrupt populations of beneficial insects. Infestations also tend to be worse in fields with wider rows or skimpy stands, and particularly during hot and dry summers.

Yellowstriped armyworm is rarely a pest, and when treatment is needed, it is almost always on seedling plants where larvae may cause excessive defoliation. Larvae are typically dark in color with a prominent yellow stripe running the length of its body on either side. They usually have an obvious dark spot on either side of the body on the body segment behind the last pair of true legs. The thorax, where the true legs are located, of smaller larvae tends to be slightly wider than the rest of the body (giving it a barrel chested appearance). Larvae sometimes feed on flowers or small pods. However, treatment is rarely if ever needed once blooming has begun.

**Sampling:** In an average sized field, take 25 sweeps with a sweep net and count the number and kinds of larvae that are found at 4 locations. Increase the number of sampling sites in large fields (> 50 acres). Also, visually estimate percent defoliation at each sampling point and evaluate if and how much pod feeding is occurring. It is important to document what other pests are present and may also be contributing to defoliation or pod feeding.

**Treatment Thresholds:** Treatment should be made if defoliation levels exceed 30 percent prior to bloom (R1), 20 percent from bloom to full seed (R1-R6), and 30 percent after R6 to R6 plus 7-10 days. For fall armyworm, and once pods are present, treat when an average of 9 or more larvae is found per 25 sweeps (or if 1 or more larvae are found per foot of row).

- **Scout closely for fall armyworm on grassy weeds when making herbicide applications, particularly on late planted fields where a lot of grasses are present.**
- **Infestations originating from grasses may be easier to control with insecticides such as pyrethroids.**
- **Use of disruptive insecticides such as pyrethroids may worsen infestations of beet armyworm.**

| <b>Insecticide (Trade Names) for FALL ARMYWORM</b>    | <b>Lb Active Ingredient per Acre</b> | <b>Amount Formulation per Acre</b> | <b>Performance Rating</b> |
|---|--------------------------------------|------------------------------------|---------------------------|
| acephate 90 (Orthene 90S)                             | 0.75 - 0.99                          | 0.83 - 1.10 lb                     | 6                         |
| bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E)    | 0.063 - 0.10                         | 4 - 6.4 oz                         | 8                         |
| chlorantraniliprole (Prevathon 0.43 SC)               | 0.047 - 0.067                        | 14 - 20 oz                         | 9                         |
| chlorantraniliprole, $\lambda$ -cyhalothrin (Besiege) | See label                            | 8 - 10 oz                          | 9                         |
| indoxacarb (Steward 1.25)                             | 0.055 - 0.11                         | 5.6 - 11.3 oz                      | 8                         |
| methomyl (Lannate LV 2.4)                             | 0.23 - 0.45                          | 12 - 24 oz                         | 7                         |
| methoxyfenozide (Intrepid 2)                          | 0.063 - 0.125                        | 4 - 8 oz                           | 8                         |
| spinetoram (Radiant SC 1)                             | 0.031                                | 4 oz                               | 8                         |
| spinetoram, methoxyfenozide (Intrepid Edge)           | See label                            | 4 - 6.4 oz                         | 9                         |
| spinosad (Blackhawk 36% WDG)                          | 0.038 - 0.05                         | 1.7 - 2.2 oz                       | 7                         |
| $\beta$ -cyfluthrin (Baythroid XL 1) *                | 0.0125 - 0.022                       | 1.6 - 2.8 oz                       | 7                         |
| $\gamma$ -cyhalothrin (Declare 1.25)                  | 0.065 - 0.075                        | 1.28 - 1.54 oz                     | 7                         |
| $\lambda$ -cyhalothrin (Karate 2.08, Warrior II)      | 0.025 - 0.03                         | 1.6 - 1.92 oz                      | 7                         |
| Z-cypermethrin (Mustang Max 0.8E)                     | 0.020 - 0.025                        | 3.2 - 4 oz                         | 7                         |

\* First and second instars (small larvae) only

| <b>Insecticide (Trade Names) for BEET ARMYWORM</b>    | <b>Lb Active Ingredient per Acre</b> | <b>Amount Formulation per Acre</b> | <b>Performance Rating</b> |
|---|--------------------------------------|------------------------------------|---------------------------|
| chlorantraniliprole (Prevathon 0.43 SC)               | 0.047 - 0.067                        | 14 - 20 oz                         | 9?                        |
| chlorantraniliprole, $\lambda$ -cyhalothrin (Besiege) | See label                            | 10 oz                              | 9?                        |
| indoxacarb (Steward 1.25)                             | 0.055 - 0.11                         | 5.6 - 11.3 oz                      | 8                         |
| methoxyfenozide (Intrepid 2)                          | 0.063 - 0.125                        | 4 - 8 oz                           | 8                         |
| spinetoram (Radiant SC 1)                             | 0.031                                | 4 oz                               | 8?                        |
| spinetoram, methoxyfenozide (Intrepid Edge)           | See label                            | 4 - 6.4 oz                         | 9                         |
| spinosad (Blackhawk 36% WDG)                          | 0.038 - 0.05                         | 1.7 - 2.2 oz                       | 7                         |

| <b>Insecticide (Trade Names) for YELLOWSTRIPED ARMYWORM</b> | <b>Lb Active Ingredient per Acre</b> | <b>Amount Formulation per Acre</b> | <b>Performance Rating</b> |
|---|--------------------------------------|------------------------------------|---------------------------|
| bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E)          | 0.063 - 0.10                         | 4 - 6.4 oz                         | 8                         |
| chlorantraniliprole, $\lambda$ -cyhalothrin (Besiege)       | See label                            | 8 - 10 oz                          | 9?                        |
| indoxacarb (Steward 1.25)                                   | 0.055 - 0.11                         | 5.6 - 11.3 oz                      | 8                         |
| methoxyfenozide (Intrepid 2)                                | 0.063 - 0.125                        | 4 - 8 oz                           | 8                         |
| spinetoram, methoxyfenozide (Intrepid Edge)                 | See label                            | 4 - 6.4 oz                         | 9                         |
| spinosad (Blackhawk 36% WDG)                                | 0.038 - 0.05                         | 1.7 - 2.2 oz                       | 7                         |
| $\beta$ -cyfluthrin (Baythroid XL 1)                        | 0.0125 - 0.022                       | 1.6 - 2.8 oz                       | 7                         |
| $\gamma$ -cyhalothrin (Declare 1.25)                        | 0.0125 - 0.015                       | 1.28 - 1.54 oz                     | 7                         |
| $\lambda$ -cyhalothrin (Karate 2.08, Warrior II)            | 0.025 - 0.03                         | 1.6 - 1.92 oz                      | 7                         |
| Z-cypermethrin (Mustang Max 0.8E)                           | 0.020 - 0.025                        | 3.2 - 4 oz                         | 7                         |

## Bean Leaf Beetle

The bean leaf beetle is almost always present in soybean fields and sometimes causes economic injury. Adults are about 1/4 inch (6 mm) in length and sometimes have pairs of black spots on their wings. The color of adult beetles varies, but they are usually reddish, yellowish, or tannish. A key identifying characteristic of bean leaf beetles is a rear-facing black triangle on the top of the wings just behind the thorax. Eggs are laid on the soil surface and larvae are found in the soil, where they cause little injury and are rarely seen.

Adult bean leaf beetles damage soybean plants by chewing holes in leaves and may occasionally feed on pods. Holes in leaves are roughly spherical in shape. In very rare cases, heavy feeding by first generation beetles on seedling plants can lead to stand loss. However, most economic damage is caused by defoliation of larger soybeans from later generations. Bean leaf beetle is also a vector of bean pod mottle virus. Soybean plants infected with bean pod mottle virus can show a variety of symptoms from chlorotic leaf mottling, puckering, and necrosis. This virus may also cause harvest problems as it may cause “green stem syndrome,” a disorder where the soybean stem stays green even after the plant has matured, making harvest more difficult. Although there is potential for economic loss from bean pod mottle virus, it is rarely a major concern in Tennessee.

**Sampling:** In an average sized field, take 25 sweeps with a sweep net and count the number of beetles that are found at 4 locations. Increase the number of sampling sites in large fields (> 50 acres). Also, visually estimate percent defoliation at each sampling point. It is important to document what other pests are present and may also be contributing to defoliation.

**Treatment Thresholds:** Treat at 30 percent defoliation until bloom (R1), 20 percent from bloom to full seed (R1-R6), and 30 percent after R6 to R6 plus 7-10 days. Alternatively, insecticide treatment can be made when infestations average 2 bean leaf beetles per sweep (50/25 sweeps), but this is generally not suggested unless defoliation is already near the threshold level.

Insecticide seed treatments such as Cruiser, Gaucho and NipsIt Inside provide protection to small seedlings and can help prevent the spread of bean pod mottle virus.

- **Early season infestations are often concentrated in the first emerging soybean fields in the area. These infestations will often subside once plants in other fields begin to emerge.**
- **Late season infestations are often worst in the latest maturing fields. Adults are very mobile, and reinfestations can occur quickly, reducing the efficacy of control.**

| Insecticide (Trade Names) for BEAN LEAF BEETLE       | Lb Active Ingredient per Acre | Amount Formulation per Acre | Performance Rating |
|--|-------------------------------|-----------------------------|--------------------|
| acephate 90 (Orthene 90S)                            | 0.75 - 0.99                   | 0.83 - 1.10 lb              | 6                  |
| bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E) * | 0.063 - 0.10                  | 4 - 6.4 oz                  | 7                  |
| chlorpyrifos (Lorsban 4E, Nufos 4E)                  | 0.5 - 1.0                     | 16 - 32 oz                  | 5?                 |
| chlorpyrifos (Lorsban Advanced 3.755)                | 0.5 - 0.94                    | 17 - 32 oz                  | 5?                 |
| esfenvalerate (Asana XL 0.66E) *                     | 0.03 - 0.05                   | 5.8 - 9.6 oz                | 5                  |
| methomyl (Lannate LV 2.4)                            | 0.23 - 0.45                   | 12 - 24 oz                  | 5                  |
| permethrin (Pounce 3.2E) *                           | 0.05 - 0.1                    | 2 - 4 oz                    | 6                  |
| $\beta$ -cyfluthrin (Baythroid XL 1) *               | 0.0125 - 0.022                | 1.6 - 2.8 oz                | 5                  |
| $\gamma$ -cyhalothrin (Declare 1.25) *               | 0.0075 - 0.0125               | 0.77 - 1.28 oz              | 6                  |
| $\lambda$ -cyhalothrin (Karate 2.08, Warrior II) *   | 0.015 - 0.025                 | 0.96 - 1.6 oz               | 7                  |
| Z-cypermethrin (Mustang Max 0.8E) *                  | 0.0175 - 0.025                | 2.8 - 4 oz                  | 7                  |

\* Control with pyrethroid insecticides may vary because of resistance in some populations of bean leaf beetles. This appears more common in the western region of the state, and particularly in the area near the Mississippi River Delta. Tank mixing acephate (0.5 lb active ingredient) with a pyrethroid insecticide will improve control.

## Blister Beetle, Japanese Beetle and Mexican Bean Beetle

Blister beetles, Japanese beetles, and Mexican bean beetles are part of a defoliating beetle complex found in soybean that may also include bean leaf beetle, grape colaspis and spotted cucumber beetle. Individually, these pests will seldom do enough leaf feeding to cause economic damage, but together or in combination with other defoliators, treatment is occasionally needed.

Blister beetles get their name from the defensive secretion, cantharidin, they secrete from the joints of their legs when disturbed, which can cause burning and blistering of the skin. Adults are soft-bodied beetles. Their appearance varies based on species, but adults are roughly 2 cm (3/4 inch) in length. The striped blister beetle has alternating dark brown and yellow stripes along the length of the body. The margined blister beetle is black with a gray border along the margins of its wing covers. The prothorax of blister beetles, the area between the head and the wings, is narrower than the head and the wings. Larvae are grub-like and found in the soil. Adults of both species, and especially the striped blister beetle, feed in clusters and skeletonize soybean leaves, making large and irregular holes between the leaf veins. Some soybean varieties are more preferred by blister beetles than others. Feeding is typically localized to a few small areas of the field, and often times, blister beetles will leave a soybean field as quickly as they arrived.

Japanese beetles can be a pest of gardens, trees, ornamental plants and agricultural fields. Adults have a bright metallic green head and thorax with copper colored elytra (hardened wings) and a row of five spots of white hairs on each side of the abdomen below the wings. They are oval shaped and vary in length from 8-11 mm (3/8-1/2 inch) and a width of 5-7 mm (1/4 inch). Larvae or “white grubs” are found in the soil and do not cause economic damage in soybean. Japanese beetles have one generation per year in Tennessee. Adults typically emerge from late May through July and often feed in small clusters. Japanese beetles primarily feed on the upper foliage of soybean, consuming leaf tissue between veins and leaving a lace-like skeleton.

Mexican bean beetles belong to the same family of insects as the lady beetles. Adults are copper colored with 16 black spots on its back. Larvae are yellow to brown with many spines on the back and sides. Adults and full-grown larvae are about 6 mm long (1/4 inch), and both damage soybean by feeding on the undersides of leaves, resulting in a lacy skeletonized appearance. Mexican bean beetles rarely occur at economically damaging levels, and this primarily occurs in the central and eastern parts of Tennessee.

**Sampling:** Sweep-net sampling and visual scouting can be used to determine which insects are causing defoliation in soybean fields. This may include beetles, caterpillars, grasshoppers, and other insects. Visually estimate percent defoliation at each sampling point.

**Treatment Thresholds:** Treat at 30 percent defoliation until bloom (R1), 20 percent from bloom to full seed (R1-R6), and 30 percent after R6 to R6 plus 7-10 days.

- **Although pyrethroid insecticides such as those listed above are generally used, other pyrethroids or other classes of insecticides may be labeled for at least one of these species.**
- **For more information see [http://utcropl.com/soybean/soybean\\_insects/SoybeanBeetles.htm](http://utcropl.com/soybean/soybean_insects/SoybeanBeetles.htm).**

| Insecticide (Trade Names) for BLISTER BEETLE, JAPANESE BEETLE, AND MEXICAN BEAN BEETLE | Lb Active Ingredient per Acre | Amount Formulation per Acre | Performance Rating |
|--|-------------------------------|-----------------------------|--------------------|
| bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E)                                     | 0.063 - 0.10                  | 4 - 6.4 oz                  | 9                  |
| β-cyfluthrin (Baythroid XL 1)  | 0.0125 - 0.022                | 1.6 - 2.8 oz                | 8 - 9              |
| γ-cyhalothrin (Declare 1.25)   | 0.0125 - 0 .015               | 1.28 - 1.54 oz              | 8 - 9              |
| λ-cyhalothrin (Karate 2.08, Warrior II)  | 0.025 - 0.03                  | 1.6 - 1.9 oz                | 8 - 9              |
| Z-cypermethrin (Mustang Max 0.8E)  | 0.0175 - 0.025                | 2.8 - 4 oz                  | 8 - 9              |

## Corn Earworm

Caterpillars (larvae) of the corn earworm, also called the bollworm or podworm, may cause occasional but serious damage to soybean by feeding on flowers and pods. Some leaf feeding may also be observed but is rarely a concern. Large caterpillars may be green, brown or yellow, with light and dark stripes running the length of the body, and they also have sparse setae (hairs) on their bodies. Larvae reach a length of 1.5 inches and have four pairs of prolegs and a pale brown or orange head.

**Sampling:** Focus sampling for corn earworm beginning at flowering (R1), and pay special attention to late maturing fields. Moth catches in pheromone traps can indicate times when scouting for corn earworm should be intensified. Take 25 sweeps with a sweep net and count the number of larvae that are found at 4 locations. Increase the number of sampling sites in large fields (> 50 acres). Also document what other pests are present and may be contributing to pod feeding, such as fall armyworm.

**Treatment Thresholds:** Treatment for corn earworm is most likely when plants are blooming and through the early pod development period (R5). Treatment is generally not recommended prior to flowering. The suggested treatment threshold, based on sweep-net sampling, is shown in the table below. To determine the treatment level, estimate the potential value of the crop and the cost of the insecticide application. For example – if the crop value is \$8/bushel and the cost of control is \$14/acre, including application costs, the sweep-net threshold would be an average of 8.6 larvae per 25 sweeps. Alternatively, treatment should be considered if an average of 1 or more larvae is found per foot of row.

- **Infestations are far more likely in late maturing soybean. Planting early and planting early-maturing varieties can help avoid infestations that typically occur beginning in August.**
- **Moths prefer to lay eggs in open canopies, so infestations are often worse in fields with a wide row spacing or when plant populations are low.**
- **Avoid unnecessary applications of insecticides that may disrupt populations of beneficial insects.**



| Crop Value<br>(\$/bu) | Number of Corn Earworm Larvae/25 Sweeps       |     |     |      |      |      |      |
|-----------------------|---|-----|-----|------|------|------|------|
|                       | Control Costs (\$/acre) Including Application |     |     |      |      |      |      |
|                       | 8   | 10  | 12  | 14   | 16   | 18   | 20   |
| 6                     | 6.5   | 8.2 | 9.8 | 11.4 | 13.1 | 14.7 | 16.3 |
| 7                     | 5.6   | 7   | 8.4 | 9.8  | 11.2 | 12.6 | 14   |
| 8                     | 5   | 6.1 | 7.4 | 8.6  | 9.8  | 11   | 12.3 |
| 9                     | 5   | 5.4 | 6.5 | 7.6  | 8.7  | 9.8  | 10.9 |
| 10                    | 5   | 5   | 5.9 | 6.9  | 7.8  | 8.8  | 9.8  |
| 12                    | 5   | 5   | 5   | 5.7  | 6.5  | 7.4  | 8.2  |
| 13                    | 5   | 5   | 5   | 5.3  | 6    | 6.8  | 7.5  |
| 15                    | 5   | 5   | 5   | 5    | 5.2  | 5.9  | 6.5  |

| Insecticide (Trade Names) for CORN EARWORM            | Lb Active Ingredient per Acre | Amount Formulation per Acre | Performance Rating |
|---|-------------------------------|-----------------------------|--------------------|
| bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E) *  | 0.063 - 0.10                  | 4 - 6.4 oz                  | 6                  |
| chlorantraniliprole (Prevathon 0.43 SC)               | 0.047 - 0.067                 | 14 - 20 oz                  | 9                  |
| chlorantraniliprole, $\lambda$ -cyhalothrin (Besiege) | See label                     | 6 - 8 oz                    | 9                  |
| esfenvalerate (Asana XL 0.66E) *                      | 0.03 - 0.05                   | 5.8 - 9.6 oz                | 6                  |
| indoxacarb (Steward 1.25)                             | 0.055 - 0.11                  | 5.6 - 11.3 oz               | 8                  |
| methomyl (Lannate LV 2.4)                             | 0.23 - 0.45                   | 12 - 24 oz                  | 7                  |
| NPV virus (Heligen) **                                | ----                          | 1.0 - 1.6 oz                | 6                  |
| permethrin (Pounce 3.2E) *                            | 0.1 - 0.2                     | 4 - 8 oz                    | 5                  |
| spinetoram (Radiant SC 1)                             | 0.031                         | 4 oz                        | 8                  |
| spinetoram, methoxyfenozide (Intrepid Edge)           | See label                     | 4 - 6.4 oz                  | 8                  |
| spinosad (Blackhawk 36% WDG)                          | 0.038 - 0.05                  | 1.7 - 2.2 oz                | 8                  |
| $\beta$ -cyfluthrin (Baythroid XL 1) *                | 0.0125 - 0.022                | 1.6 - 2.8 oz                | 6                  |
| $\gamma$ -cyhalothrin (Declare 1.25) *                | 0.0098 - 0.0125               | 1 - 1.28 oz                 | 6                  |
| $\lambda$ -cyhalothrin (Karate 2.08, Warrior II) *    | 0.015 - 0.025                 | 0.96 - 1.6 oz               | 6                  |
| Z-cypermethrin (Mustang Max 0.8E) *                   | 0.0175 - 0.025                | 2.8 - 4 oz                  | 6                  |

Corn earworm has developed some level of resistance to pyrethroid insecticides. Thus, they may not provide adequate control. Use another insecticide or tank mix acephate (at least 0.5 lb active ingredient) with a pyrethroid insecticide if infestations are well above the threshold level.

\*\* NPV virus (Heligen) will only control corn earworm. Applications should be made when larvae are small. Do not apply if most larvae are large or if infestations are well above treatment threshold.

## Grasshoppers

Grasshoppers are a generalist group of plant feeders. Short-horned grasshoppers (family Acrididae) are most commonly observed in soybean. They have short, thread-like antennae with enlarged hind legs which aid in jumping. Grasshoppers have chewing mouthparts, and the adults have two pairs of wings that are folded over their 'backs' when not flying. Adults of some species can exceed 2 inches in length. The color patterns of grasshoppers vary considerably because there are multiple species observed in soybean, colors change as they molt from one life stage to another, and because their colors may change to match their environment.

Grasshoppers are an occasional pest of soybean. However, some fields in Tennessee require an insecticide application in most years. Grasshoppers feed primarily on foliage and are part of the defoliating pest complex in soybean, but feeding on flowers, pods and other plant parts is sometimes observed. Leaf feeding is characterized by irregular holes that extend in from the leaf margins or between the leaf veins. Plants are most susceptible to

damage when they are small, from the time of emergence to V2. Thus, most serious infestations are seen on seedling soybean plants. Both immatures (nymphs) and adults may feed on the main stems of seedlings and reduce plant stands to the point where replanting is needed. However, serious damage is usually caused by large numbers of nymphs. Grasshopper infestations are often worse following a dry year.

**Sampling:** Grasshoppers tend to concentrate on field edges first before dispersing further into the field and are easily observed or caught with a sweep net. However, insecticide treatment is generally based on average defoliation levels and the potential to cause stand loss.

**Treatment Thresholds:** Treatment is suggested when an unacceptable level of stand loss is occurring or defoliation exceeds 30 percent. Treatment specifically for grasshoppers is rarely needed once blooming has begun, but as part of a defoliator complex, treatment is recommended between first bloom (R1) and full seed (R6) when 20 percent or more defoliation is observed.

- **Grasshoppers are primarily a problem in reduced-tilled fields because tillage can destroy egg masses.**
- **A beneficial cultural practice is to mow ditch banks and field edges before crop emergence to minimize the optimal habitat for grasshoppers before they relocate into cropping fields.**

| Insecticide (Trade Names) for GRASSHOPPERS         | Lb Active Ingredient per Acre | Amount Formulation per Acre | Performance Rating |
|--|-------------------------------|-----------------------------|--------------------|
| acephate 90 (Orthene 90S)                          | 0.30 - 0.50                   | 0.33 - 0.56 lb              | 8                  |
| bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E) | 0.063 - 0.10                  | 4 - 6.4 oz                  | 7                  |
| chlorpyrifos (Lorsban 4E, Nufos 4E)                | 0.25 - 0.50                   | 8 - 16 oz                   | 7                  |
| chlorpyrifos (Lorsban Advanced 3.755)              | 0.25 - 0.47                   | 8.5 - 16 oz                 | 7                  |
| diflubenzuron (Dimilin 2L), for immatures only     | 0.031                         | 2 oz                        | 8                  |
| esfenvalerate (Asana XL 0.66E)                     | 0.03 - 0.05                   | 5.8 - 9.6 oz                | 7                  |
| β-cyfluthrin (Baythroid XL 1)                      | 0.0155 - 0.022                | 2.1 - 2.8 oz                | 7                  |
| γ-cyhalothrin (Declare 1.25)                       | 0.0125 - 0.015                | 1.28 - 1.54 oz              | 7                  |
| λ-cyhalothrin (Karate 2.08, Warrior II)            | 0.025 - 0.030                 | 1.6 - 1.9 oz                | 7                  |
| Z-cypermethrin (Mustang Max 0.8E)                  | 0.020 - 0.025                 | 3.2 - 4 oz                  | 7                  |

## Green Cloverworm

Green cloverworms are commonly found in soybean. The caterpillar (larva) is green, slender and reaches a length of about 1 inch. It has three pairs of abdominal prolegs. This distinguishes it from other caterpillars found in soybean. It feeds only on leaves, and the feeding damage is similar to that of loopers. Smaller green cloverworm larvae crawl in a looping, inch-worm fashion similar to loopers. However, green cloverworm larvae often wriggle spastically when disturbed or prodded, helping to distinguish them from loopers. They may be found at any time during the season, but they are damaging only at high populations or in combination with other defoliators.

**Sampling:** In an average sized field, take 25 sweeps with a sweep net and count the number of larvae that are found at 4 locations. Increase the number of sampling sites in large fields (> 50 acres). Also, visually estimate percent defoliation at each sampling point. It is important to document what other pests are present and may also be contributing to defoliation.

**Treatment Thresholds:** Treat at 30 percent defoliation until bloom (R1), 20 percent from bloom to full seed (R1-R6), and 30 percent after R6 to R6 plus 7-10 days. Alternatively, treatment can be made based on a threshold of 38 green cloverworms per 25 sweeps.

- **Do not confuse green cloverworm (3 pairs of prolegs) with loopers (2 pairs), which are more difficult to control with insecticides.**

| Insecticide (Trade Names) for GREEN CLOVERWORM        | Lb Active Ingredient per Acre | Amount Formulation per Acre | Performance Rating |
|---|-------------------------------|-----------------------------|--------------------|
| acephate 90 (Orthene 90S)                             | 0.75 - 0.99                   | 0.83 - 1.10 lb              | 8                  |
| bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E)    | 0.063 - 0.10                  | 4 - 6.4 oz                  | 9                  |
| chlorantraniliprole (Prevathon 0.43 SC)               | 0.047 - 0.067                 | 14 - 20 oz                  | 9                  |
| chlorantraniliprole, $\lambda$ -cyhalothrin (Besiege) | See label                     | 6 - 8 oz                    | 9                  |
| chlorpyrifos (Lorsban 4E, Nufos 4E)                   | 0.25 - 0.5                    | 8 - 16 oz                   | 8                  |
| chlorpyrifos (Lorsban Advanced 3.755)                 | 0.25 - 0.47                   | 8.5 - 16 oz                 | 8                  |
| diflubenzuron (Dimilin 2)                             | 0.031 - 0.063                 | 2 - 4 oz                    | 9                  |
| esfenvalerate (Asana XL 0.66E)                        | 0.015 - 0.03                  | 2.9 - 5.8 oz                | 9                  |
| indoxacarb (Steward 1.25)                             | 0.055 - 0.11                  | 5.6 - 11.2 oz               | 9                  |
| methomyl (Lannate LV 2.4)                             | 0.23 - 0.45                   | 12 - 24 oz                  | 9                  |
| methoxyfenozide (Intrepid 2)                          | 0.063 - 0.125                 | 4 - 8 oz                    | 9                  |
| permethrin (Pounce 3.2E)                              | 0.05 - 0.1                    | 2 - 4 oz                    | 8                  |
| spinetoram (Radiant SC 1)                             | 0.016 - 0.031                 | 2 - 4 oz                    | 9                  |
| spinetoram, methoxyfenozide (Intrepid Edge)           | See label                     | 4 - 6.4 oz                  | 9                  |
| spinosad (Blackhawk 36% WDG)                          | 0.034 - 0.05                  | 1.1 - 2.2 oz                | 9                  |
| $\beta$ -cyfluthrin (Baythroid XL 1)                  | 0.025 - 0.044                 | 1.6 - 2.8 oz                | 9                  |
| $\gamma$ -cyhalothrin (Declare 1.25)                  | 0.0075 - 0.0125               | 0.77 - 1.28 oz              | 9                  |
| $\lambda$ -cyhalothrin (Karate 2.08, Warrior II)      | 0.015 - 0.025                 | 0.96 - 1.6 oz               | 9                  |
| Z-cypermethrin (Mustang Max 0.8E)                     | 0.0175 - 0.025                | 2.8 - 4 oz                  | 9                  |

## Kudzu Bug

Infestations of kudzu bug on kudzu or soybean have been reported from most soybean producing areas of Tennessee, and this invasive insect has spread rapidly through the state. Adult kudzu bugs are about the same size as adult lady beetles. They are approximately 1/4-inch long, almost square in shape with a brown to olive-green hue. The immature stages are more rounded, smaller and “hairy.” Eggs of kudzu bugs are light-colored, barrel-shaped, and placed on leaves or other plant parts in two rows. Kudzu bugs are generally found on the stems where they feed on plant juices (phloem). They do not feed on seeds. It takes many kudzu bugs to cause economic damage to soybean, but infestation levels may reach hundreds of bugs per plant.

**Sampling:** In an average sized field, take 25 sweeps with a sweep net and count the number of immature kudzu bugs that are found at 4 locations. Increase the number of sampling sites in large fields (> 50 acres). Kudzu bug infestations often begin once plants start blooming. Infestations in soybean, at least initially, are often concentrated on field edges. Randomly select sampling locations and make treatment based on field average counts.

**Treatment Thresholds:** Treat between emergence and R1 when 5 or more kudzu bugs are found per plant. From R1 to R7, treat when an average of 1 or more immature kudzu bugs are present per sweep (25 per 25 sweeps).

- **Treatment based only on the presence of adults is generally discouraged because reinfestations may occur quickly, and it takes sustained infestations to cause yield loss.**
- **One well-timed insecticide application will generally provide satisfactory control.**

- **A white-colored fungus, *Beauveria bassiana*, often attacks kudzu bugs and suppresses or almost completely controls infestations.**

| Insecticide (Trade Names) for KUDZU BUG            | Lb Active Ingredient per Acre | Amount Formulation per Acre | Performance Rating |
|--|-------------------------------|-----------------------------|--------------------|
| acephate 90 (Orthene 90S)                          | 0.75 - 0.99                   | 0.83 - 1.10 lb              | 7                  |
| bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E) | 0.078 - 0.10                  | 5 - 6.4 oz                  | 9+                 |
| γ-cyhalothrin (Declare 1.25)                       | 0.0125 - 0.015                | 1.28 - 1.54 oz              | 8                  |
| λ-cyhalothrin (Karate 2.08, Warrior II)            | 0.031                         | 1.92 oz                     | 9                  |
| Z-cypermethrin (Mustang Max 0.8E)                  | 0.025                         | 4 oz                        | 9                  |

## Saltmarsh Caterpillar

Saltmarsh caterpillars and other woolly worms are commonly found in soybean. Larvae feed only on leaves and occasionally cause enough defoliation to justify treatment. The feeding damage is similar to that of other defoliating caterpillars. Eggs are laid in a mass, usually on leaves, and the small, light-colored and somewhat hairy larvae may be found clustered together after hatching. Larger larvae of the saltmarsh caterpillars are hairy and vary considerably in color, although they tend to be white, yellowish, or cream colored when an outbreak occurs. The larvae have four pairs of prolegs and grow to a length exceeding 2 inches.

**Sampling:** Saltmarsh caterpillars may be found at any time during the season, but they are most commonly observed after flowering has begun. In an average sized field, take 25 sweeps with a sweep net and count the number of larvae that are found at 4 locations. Increase the number of sampling sites in large fields (> 50 acres). Also, visually estimate percent defoliation at each sampling point. It is important to document what other pests are present and may also be contributing to defoliation.

**Treatment Thresholds:** Treat at 30 percent defoliation until bloom (R1), 20 percent from bloom to full seed (R1-R6), and 30 percent after R6 to R6 plus 7-10 days.

- **A naturally occurring fungus that attacks saltmarsh caterpillars will sometimes quickly reduce infestation levels.**

| Insecticide (Trade Names) for SALTMARSH CATERPILLAR | Lb Active Ingredient per Acre | Amount Formulation per Acre | Performance Rating |
|---|-------------------------------|-----------------------------|--------------------|
| bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E)  | 0.063 - 0.10                  | 4 - 6.4 oz                  | 6                  |
| chlorantraniliprole, λ-cyhalothrin (Besiege)        | See label                     | 6 - 8 oz                    | 9                  |
| esfenvalerate (Asana XL 0.66E)                      | 0.015 - 0.03                  | 2.9 - 5.8 oz                | 6                  |
| methoxyfenozide (Intrepid 2)                        | 0.063 - 0.125                 | 4 - 8 oz                    | 8                  |
| permethrin (Arctic 32, Pounce 3.2)                  | 0.05 - 0.1                    | 2 - 4 oz                    | 6                  |
| spinetoram (Radiant SC 1)                           | 0.016 - 0.031                 | 2 - 4 oz                    | 9                  |
| spinetoram, methoxyfenozide (Intrepid Edge)         | See label                     | 4 - 6.4 oz                  | 9                  |
| spinosad (Blackhawk 36% WDG)                        | 0.039 - 0.05                  | 1.7 - 2.2 oz                | 9                  |
| β-cyfluthrin (Baythroid XL 1)                       | 0.013 - 0.022                 | 1.6 - 2.8 oz                | 6                  |
| γ-cyhalothrin (Declare 1.25)                        | 0.0075 - 0.0125               | 0.77 - 1.28 oz              | 6                  |
| λ-cyhalothrin (Karate 2.08, Warrior II)             | 0.015 - 0.025                 | 0.96 - 1.6 oz               | 6                  |
| Z-cypermethrin (Mustang Max 0.8E)                   | 0.0175 - 0.025                | 2.8 - 4 oz                  | 6                  |

## Soybean Aphid

Soybean aphid is a relatively new, invasive pest in Tennessee. Economically damaging infestations are rare and more likely in the eastern one-half of the state. Soybean aphids are pale yellow, small, and soft-bodied insects typically found on the undersides of leaves or on stems where they feed on sap (phloem) with piercing-sucking mouthparts. Most aphids will lack wings. They are the only aphid found in soybean that will occur in large numbers. Feeding by immatures and adults may result in the accumulation of honeydew on the plant. Previous infestations in Tennessee have mostly occurred later in the season when temperatures have been relatively mild. Soybean mosaic virus and other viral diseases are sometimes transmitted by aphids during feeding.

**Sampling:** For soybean aphids, begin scouting in early July. Look for aphids on the undersides of upper and middle canopy leaves. Estimate aphid density per plant at 5-10 locations throughout the field.

**Treatment Thresholds:** Treat when an average of 250 aphids or more is found per plant from early bloom (R1) until early pod fill (R5). Treatment after R5 is less likely to increase yield. Treatment should also be considered if honeydew is accumulating in the field at any time before R5.

| Insecticide (Trade Names) for SOYBEAN APHID        | Lb Active Ingredient per Acre | Amount Formulation per Acre | Performance Rating |
|--|-------------------------------|-----------------------------|--------------------|
| acephate 90 (Orthene 90S)                          | 0.75 - 0.99                   | 0.83 - 1.10 lb              | 8                  |
| bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E) | 0.063 - 0.10                  | 4 - 6.4 oz                  | 9                  |
| chlorpyrifos (Lorsban 4E, Nufos 4E)                | 0.50 - 1.0                    | 16 - 32 oz                  | 8                  |
| chlorpyrifos (Lorsban Advanced 3.755)              | 0.50 - 0.94                   | 17 - 32 oz                  | 8                  |
| $\gamma$ -cyhalothrin (Declare 1.25)               | 0.010 - 0.0125                | 1.0 - 1.28 oz               | 9                  |
| $\lambda$ -cyhalothrin (Karate 2.08, Warrior II)   | 0.025 - 0.030                 | 1.6 - 1.9 oz                | 9                  |
| Z-cypermethrin (Mustang Max 0.8E)                  | 0.0175 - 0.025                | 2.8 - 4 oz                  | 9                  |

## Soybean Looper

Loopers are a common defoliating caterpillar found in soybeans. They do not feed on pods. Both soybean looper and cabbage looper may be present. However, in Tennessee, economically damaging infestations are uncommon until mid-August and September, and these infestations are often composed mostly of the soybean looper. Larvae of both species are light green and have two pairs of prolegs (excluding the pair on the last abdominal segment). The caterpillars move with an inch-worm or looping fashion when crawling. The body is thickest at the rear and tapers to the head, reaching a length of about 1.3 inches. Populations are often held in check by beneficial insects and diseases.

**Sampling:** In an average sized field, take 25 sweeps with a sweep net and count the number and kinds of larvae that are found at 4 locations. Increase the number of sampling sites in large fields (> 50 acres). Also, visually estimate percent defoliation at each sampling point. It is important to document what other pests are present and may also be contributing to defoliation.

**Treatment Thresholds:** Treat at 30 percent defoliation until bloom (R1), 20 percent from bloom to full seed (R1-R6), and 30 percent after R6 to R6 plus 7-10 days. Alternatively, an insecticide application can be made when infestations average 19 loopers per 25 sweeps, but it is generally suggested not to count larvae less than ½-inch long because small larvae do not cause much defoliation and natural mortality is often high.

- **Late maturing varieties are much more likely to be infested with soybean loopers.**

- Soybean looper is more difficult to control with insecticides than the cabbage looper. Although many pyrethroid insecticides are labeled for soybean looper control, they are not recommended because resistance is well documented. Indeed, use of pyrethroid insecticides can worsen infestations of soybean looper.
- Soybean loopers often, but not always, have black true legs (those behind the head) and/or black spots on the bodies.
- Treatable infestations of loopers prior to August, although uncommon, are likely to be cabbage looper and can often be controlled with pyrethroid or other insecticides. It is generally best to assume late season infestations are composed mostly of soybean looper and to use recommended insecticides accordingly.
- Do not confuse loopers (2 pairs of prolegs) with green cloverworm (3 pairs), which are easier to control with insecticides.

| Insecticide (Trade Names) for LOOPERS        | Lb Active Ingredient per Acre | Amount Formulation per Acre | Performance Rating Soybean / Cabbage |
|--|-------------------------------|-----------------------------|--------------------------------------|
| chlorantraniliprole (Prevathon 0.43 SC)      | 0.047 - 0.067                 | 14 - 20 oz                  | 8 / 9                                |
| chlorantraniliprole, λ-cyhalothrin (Besiege) | See label                     | 10 oz                       | 8 / 9                                |
| indoxacarb (Steward 1.25)                    | 0.055 - 0.11                  | 5.6 - 11.3 oz               | 8 / 9                                |
| methoxyfenozide (Intrepid 2)                 | 0.063 - 0.125                 | 4 - 8 oz                    | 8 / 9                                |
| spinetoram (Radiant SC 1)                    | 0.016 - 0.031                 | 2 - 4 oz                    | 8 / 9                                |
| spinetoram, methoxyfenozide (Intrepid Edge)  | See label                     | 4 - 6.4 oz                  | 9 / 9                                |
| spinosad (Blackhawk 36% WDG)                 | 0.034 - 0.05                  | 1.1 - 2.2 oz                | 8 / 9                                |

## Other Defoliating Caterpillars

There are several other caterpillars found in soybean that may cause some level of defoliation, although it is very rare for these species to cause economic damage in Tennessee. However, a brief description is included below because these insects may be encountered.

Velvetbean Caterpillar: This insect is common in the coastal regions of the South. In Tennessee, it is sometimes found late in the growing season on late maturing soybeans, especially after one or more particularly mild winters. The larvae grow larger than most other caterpillars found in soybean and can cause substantial defoliation when present in large numbers. Color varies considerably, but when found in Tennessee, the larvae are typically green in color. Small larvae loop in an inch-worm fashion similar to green cloverworm or loopers, but velvetbean caterpillars have four pairs of prolegs. Similar to the green cloverworm, the larvae wiggle rapidly when prodded. This behavior helps to distinguish them from corn earworm with which they are sometimes confused.

Silver-Spotted Skipper: Scouts will sometimes encounter this unusual looking caterpillar in soybean. The caterpillars are easily recognized by a dark, often maroon-colored head with yellow-orange eyespots, and by having a narrow “neck” and relatively fleshy, thick green body. Larvae feed on leaves which may be loosely woven together with silk.

Painted Lady: The larvae of this butterfly will feed on soybean leaves, sometimes occurring in groups. Similar to silver-spotted skippers, the caterpillars will web leaflets together while feeding. Their color varies, and they are sometimes confused with the saltmarsh caterpillar because the larvae are hairy, although typically with shorter, stouter, and less dense ‘hairs’ (giving them a more spiny appearance).

**Sampling:** These species will be caught in sweep net or drop cloth samples, but they are typically not counted because they occur at low numbers. Any defoliation caused by these species would be accounted for while estimating defoliation caused by other pests.

**Treatment Thresholds:** Treatment for defoliating pests should be made if defoliation levels exceed 30 percent prior to bloom (R1), 20 percent from bloom to full seed (R1-R6), and 30 percent after R6 to R6 plus 7-10 days.

Insecticide applications are seldom needed for these pests in Tennessee. However, insecticides used to control other caterpillar pests generally provide effective control.

## Spider Mites

Spider mites are an occasional pest of soybeans. They are not insects, being more closely related to spiders. The twospotted spider mite is the most common mite found infesting soybeans. At full size, spider mites are only 0.3-0.4 mm long and difficult to see with the naked eye. They are pale-yellow to orange in color, and under magnification, a dark spot can be seen on either side of the body. Sometimes, a dark red body color is observed (previously called the carmine mite). The adult and nymphal stages have eight legs, but the larval stage that emerges from the egg has six legs. Both immature and adult spider mites cause injury to soybeans by sucking juices from plants. As their name suggests, a fine silken webbing is produced by the mites and may be observed on infested leaves. They may feed on all plant structures but are most commonly observed on the undersides of leaves. Infestations are often most severe during hot and dry weather. Mites reduce the plant's ability to produce photosynthate, and under severe infestations, cause premature defoliation.

**Sampling:** Sampling for mites is based on visual observations of injury symptoms, such as leaf speckling and premature yellowing of leaves, or by seeing mites on the undersides of leaves.

**Treatment Thresholds:** Thresholds for spider mites are not well established in soybean. Consider treatment when spider mites are present on the majority of plants and premature defoliation is occurring.

- **Avoid unnecessary insecticide applications that kill beneficial insects and may cause outbreaks of spider mites.**
- **Well-watered or irrigated soybean are less likely to be heavily infested or benefit from treatment.**

| Insecticide (Trade Names) for SPIDER MITES           | Lb Active Ingredient per Acre | Amount Formulation per Acre | Performance Rating |
|--|-------------------------------|-----------------------------|--------------------|
| abamectin (Agri-Mek SC 0.7)                          | 0.01 - 0.019                  | 1.75 - 3.5 oz               | 8                  |
| bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E) * | 0.063 - 0.10                  | 4 - 6.4 oz                  | 6                  |
| chlorpyrifos (Lorsban 4E, Nufos 4E) *                | 0.25 - 0.5                    | 8 - 16 oz                   | 4                  |
| chlorpyrifos (Lorsban Advanced 3.755) *              | 0.25 - 0.47                   | 8.5 - 16 oz                 | 4                  |
| dimethoate 4 *                                       | 0.5                           | 16 oz                       | 4                  |
| etoxazole (Zeal SC 2.88)                             | 0.045 - 0.135                 | 2 - 6 oz                    | 8                  |

\* These products may only provide suppression of spider mites.

## Stink Bugs

Stink bugs are common pests in Tennessee. There are several species of stink bugs that may occur in soybean, and both the adults and nymphs cause injury by feeding on developing seed with their piercing-sucking mouthparts. Adults are shield-shaped, either mostly green or brown in color, and 0.5-0.67 inches long. Immatures vary considerably in size and color, both within and among species. Stink bugs may introduce diseases into developing seeds, reduce seed size and germination, and lower milling quality. Damaged seed may appear wrinkled and smaller than normal.

The green stink bug is the most common species that feeds on soybean in Tennessee. The brown stink bug is another common component of the stink bug complex. Other plant feeding species that may be present include the red-shouldered stink bug and the dusky brown stink bug. The southern green stink bug is less common but may be observed after warm winters, particularly in the southernmost counties. The brown marmorated stink bug and the redbanded stink bug are invasive species that may also be observed in some areas of the state. Like the southern green stink bug, redbanded stink bugs are more likely to occur after a very mild winter. Finally, predatory (beneficial) stink bugs such as the spined soldier bug may also be found in soybean and are sometimes mistaken for brown or dusky brown stink bugs.

**Sampling:** Because stink bugs are seed feeders, sampling should be concentrated when plants are filling seed (R3-R6). In an average sized field, take 25 sweeps with a sweep net and count the number of adult and immature stink bugs that are found at 4 locations. Increase the number of sampling sites in large fields (> 50 acres). Stink bug eggs are characteristically laid in a mass of 20-100 barrel-shaped eggs. Easily observing stink bug adults, immatures and egg masses while walking through fields is a sign that thorough scouting is needed.

It can be important to correctly identify the kinds of stink bugs being found. Some species are more difficult to control with insecticides. Do not count predatory stink bugs, and they may be common in fields infested with caterpillars. The spined soldier bug and other predatory stink bugs have a beak approximately twice as wide as the antennae (a sword); whereas, plant-feeding stink bugs have a beak about the same width as the antennae (a needle).

**Treatment Thresholds:** From beginning bloom (R1) to full seed (R6), treat when an average of 9 or more stink bugs is found per 25 sweeps (or 1 stink bug is found per foot of row). For 7-10 days beginning at R6, treat when an average of 18 or more stink bugs is found per 25 sweeps.

- For redbanded stink bug, use a reduced treatment threshold of 4 stink bugs per 25 sweeps.

| Insecticide (Trade Names) for STINK BUGS           | Lb Active Ingredient per Acre | Amount Formulation per Acre | Performance Rating Green / Brown* |
|--|-------------------------------|-----------------------------|-----------------------------------|
| acephate 90 (Orthene 90S)                          | 0.50 - 0.99                   | 0.56 - 1.10 lb              | 8 / 9                             |
| bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E) | 0.063 - 0.10                  | 4 - 6.4 oz                  | 9 / 8                             |
| β-cyfluthrin (Baythroid XL 1)                      | 0.025 - 0.044                 | 1.6 - 2.8 oz                | 8 / 5                             |
| γ-cyhalothrin (Declare 1.25)                       | 0.0125 - 0.015                | 1.28 - 1.54 oz              | 7 / 5                             |
| λ-cyhalothrin (Karate 2.08, Warrior II)            | 0.025 - 0.030                 | 1.6 - 1.9 oz                | 8 / 5                             |
| Z-cypermethrin (Mustang Max 0.8E)                  | 0.020 - 0.025                 | 3.2 - 4 oz                  | 8 / 5                             |

\* Use acephate or relatively high rates of bifenthrin if brown stink bugs compose a significant percentage of the stink bug population. For redbanded stink bugs, use the maximum labeled rate of acephate, bifenthrin, or a tank mix of these two insecticides.

## Threecornered Alfalfa Hopper

The adult threecornered alfalfa hopper is a green, wedge-shaped insect about 1/4 inch long. They are an occasional pest of soybean. The adults are very mobile and hop when disturbed. Adults and nymphs feed by inserting their piercing-sucking mouthparts and girdling the circumference of stems or leaf petioles. A callus (girdle) is created at the site of feeding. Plants may snap over while walking through the field or during a storm if threecornered alfalfa hoppers, typically the adults, have girdled the main stem of plants less than 10-12 inches tall. Lodging is often observed long after the girdle was made and when plants are no longer susceptible to damage. Leaves may be seen turning brown where petioles have been girdled. Feeding by threecornered alfalfa hopper does not cause yield loss



unless lodging occurs, and especially when this lodging occurs during the mid or late reproductive stages (R4 and beyond).

**Sampling:** Sampling for threecornered alfalfa hoppers in seedling soybeans is difficult. Fields should be scouted for this pest from emergence until plants are 10-12 inches tall. A sweep net can be used to detect the presence of adults. Adults may also be observed hopping as you walk through the field. A sweep net handle can be used to bend seedling plants over. Girdled plants often snap when this is done. Make sure sample points are scattered over the entire field as infestations are often highest along field margins.

**Treatment Thresholds:** There is no established sweep net threshold for threecornered alfalfa hopper, but treatment may be needed if you catch more than 10 hoppers per 25 sweeps **and** when plants are less than 10 inches tall, and especially in fields where plant stands are below optimal levels. Also consider treatment if 10 percent or more of seedling plants are infested with nymphs or adults or when 50 percent or more of plants are girdled. Treatment is not generally recommended for plants greater than 12 inches tall. Fields may be re-infested quickly after an insecticide application is made, but multiple applications for this pest are rarely justified.

Insecticide seed treatments such as Cruiser, Gaucho and NipsIt Inside provide some protection during the seedling stage, but injury may still be observed, particularly in small fields or on the edges of larger fields.

- **Threecornered alfalfa hoppers are more problematic in reduced tillage systems. The highest populations are typically observed in late planted fields such as double-cropped soybeans.**
- **Lodging of plants tends to be worse in fields with low plant populations, and thus, achieving adequate plant stands can reduce the risk of economic injury.**
- **Maintaining a clean field border may help reduce population numbers.**

| Insecticide (Trade Names) for THREECORNERED ALFALFA HOPPER | Lb Active Ingredient per Acre | Amount Formulation per Acre | Performance Rating |
|--|-------------------------------|-----------------------------|--------------------|
| acephate 90 (Orthene 90S)                                  | 0.75 - 0.99                   | 0.83 - 1.10 lb              | 8                  |
| bifenthrin (Brigade 2E, Discipline 2E, Fanfare 2E)         | 0.05 - 0.10                   | 3.2 - 6.4 oz                | 9                  |
| esfenvalerate (Asana XL 0.66E)                             | 0.03 - 0.05                   | 5.8 - 9.6 oz                | 8                  |
| β-cyfluthrin (Baythroid XL 1)                              | 0.025 - 0.044                 | 1.6 - 2.8 oz                | 8                  |
| γ-cyhalothrin (Declare 1.25)                               | 0.0075 - 0.0125               | 0.77 - 1.28 oz              | 8                  |
| λ-cyhalothrin (Karate 2.08, Warrior II)                    | 0.015 - 0.025                 | 0.96 - 1.6 oz               | 8                  |
| Z-cypermethrin (Mustang Max 0.8E)                          | 0.0175 - 0.025                | 2.8 - 4 oz                  | 8                  |

## Thrips

Several kinds of thrips may be observed feeding on soybean. Common examples include tobacco thrips and soybean thrips. Thrips are small, slender insects. Adults are about 1.5-2.0 mm long and can usually be distinguished from the immatures by the presence of two pairs of wings that are held folded behind the back. Each wing is characterized by a fringe of hairs on the posterior margin, but this is not visible except under magnification. Some adults may be wingless. Depending upon the species, adult color varies from yellowish to black. Eggs are very small and are inserted into the host plant. Immature thrips found in soybeans are pale yellow to straw colored. Both immature and adult stages have modified, piercing-sucking mouthparts and feed on plant juices from the wounds made by their “beak.”

Thrips are very common insects found in soybean but rarely justify an insecticide treatment because soybean plants are tolerant to injury. Economic damage to soybeans is only likely during the seedling stage when environmental conditions result in poor seedling growth and low vigor. Feeding often causes yellow or white speckling on leaves, particularly around leaf veins, and a general stunting of plants. Leaves may be somewhat crinkled or cupped when thrips populations are high, and in rare cases, plants may be killed.

**Sampling:** Vigorously thumping seedling plants over a white surface or into a white container is sometimes done as a means of counting thrips. Visual observations of plant injury, such as leaf speckling, is also a sign of thrips infestation.

**Treatment Thresholds:** Treatment for thrips is not recommended except in rare cases when serious injury such as plant death or extreme stunting is observed. Treatment should not be made once plants have two or more trifoliate leaves.

Insecticide seed treatments such as Cruiser, Gaucho and NipsIt Inside provide some protection during the seedling stage, but poor control may be observed because of insecticide resistance in populations of tobacco thrips.

**Acephate products, such as Orthene, at a rate of 0.2-0.33 lb active ingredient per acre can be used to control infestations of thrips. Pyrethroid insecticides are not recommended.**