SDSU Extension

iGrow Soybean

BEST MANAGEMENT PRACTICES

Chapter 37:
The Identification, Biology, and Management of Two-spotted Spider Mites, Grasshoppers, and Caterpillars

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Soybean fields can frequently contain many minor pests which occasionally require control. This chapter discusses the identification, biology, and management of two-spotted spider mites, grasshoppers, caterpillars, and woolly bear caterpillars.

Description, Biology, and Management of Two-spotted Spider Mites

Description

Two-spotted spider mites *(Tetranychus urticae)* are tiny arachnids (<0.002 inch) with a yellowish to greenish translucent body and two distinctive dark spots on the sides of the body (Fig. 37.1). The telltale spots are caused by food particles that accumulate in specific sites within the body. In the field, a 10x hand lens is sufficient for mite scouting, but accurate identification of two-spotted spider mites requires a specialized microscope.

Figure 37.1. Two-spotted spider mites (*Tetranychus urticae*). Note the large dark spots on both body sides. (Photo courtesy of David Cappaert, Michigan State University, Bugwood.org)

Biology of two-spotted spider mites

Two-spotted spider mites overwinter as adults on broadleaf plants and crop residues. The overwintering mites neither feed nor lay eggs. In spring, surviving mites resume active feeding and mating. Two-spotted spider mites migrate into soybean fields in spring or summer. Infestations often begin on field edges. Female spider mites lay their eggs on the lower side of soybean leaves. The eggs hatch in 3-4 days and the nymphs take 5-10 days to develop into adults. Hot and dry summer stimulates the buildup of mite population.

Mites puncture plant cells and suck on the cell content. The accumulated punctures are visible as yellow or whitish spots on the lower side of soybean leaves. The appearance of these spots is commonly known as leaf stippling (Fig. 37.2). Mite feeding injury causes water loss and reduces leaf photosynthetic capability. Two-spotted spider mites also spin silk webbing that covers the leaf surface (Fig. 37.3). Heavy mite infestation causes early leaf senescence and pod shattering and when it occurs between late vegetative and early reproductive stages, between 40% to 60% of soybean yield may be lost.

Figure 37.2. Leaf stippling, a symptom of spider mites infestation, on soybean leaf. (Photo courtesy of Clemson University - USDA Cooperative Extension Slide Series, Bugwood.org)

Figure 37.3. Silk webbing produced by two-spotted spider mites. (Photo courtesy of David Cappaert, Michigan State University, Bugwood.org)

Natural enemies of spider mites

Field spider mite populations are naturally regulated by predators and fungal pathogens. Both larvae and adult of Stethorus beetles, for example, feed on all stages of mites (Fig. 37.4). Adult stethorus beetles can eat over 50 mite eggs or 10 adult mites per day. Application of broad spectrum pesticide may kill the predators and interrupt the natural regulation of mite populations, resulting in a sudden bouncing back of the mite population.

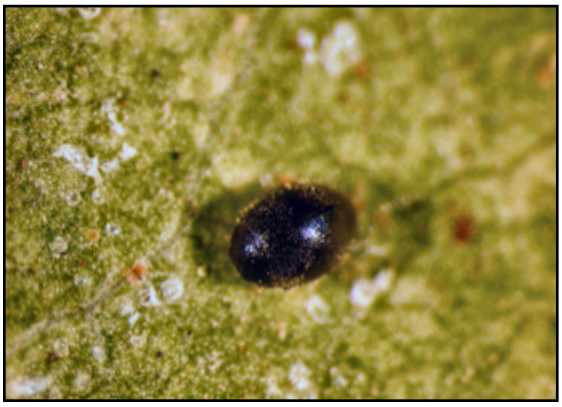

Figure 37.4. Stethorus sp. beetle, a predator of two-spotted spider mites. (Photo courtesy of Sonya Broughton, Department of Agriculture and Food Western Australia, Bugwood.org)

Table 37.1. Mite scoring according to Ostlie and Potter (2009)

Score	Observation
0	No spider mites or injury observed.
1	Stippling on lower leaves; no premature yellowing observed.
2	Stippling common on lower leaves; no premature yellowing observed.
3	Heavy stippling on lower leaves with some stippling progressing into middle canopy. Mites present in middle canopy with scattered colonies in upper canopy. Lower leaf yellowing common. Small areas with lower leaf loss.
4	Lower leaf yellowing readily apparent. Leaf drop common. Stippling, webbing and mites common in middle canopy. Mites and minor stippling present in upper canopy.
5	Lower leaf loss common. Yellowing or browning moving up plant into middle canopy. Stippling and distortion of upper leaves common. Mites present in high levels in middle and lower canopy.

Pesticide management approaches for spider mites

Confirming mite presence on stippled leaves is important since foliar disease, drought stress, and herbicide injury may cause similar symptoms. Start scouting at field edges, especially near ditches and alfalfa fields where the mites are likely to overwinter. Examine whole plants for stippled leaves, silk webbing and mite presence. Tap a stippled leaf over a black paper sheet (such as construction paper) and examine the sheet using 10x hand lens for mites. The presence of silk webbing on soybean leaves confirms mite infestation on the plant. If mites are found at the edge of the field, start scouting the inner field. Walk the field in a U pattern, stop randomly at 20 sites, and examine at least two plants at every site (Chapter 29). Score each plant according to Table 37.1.

After scoring the plants, divide the total score by the number of plants examined to arrive at the field average score. In drought conditions, mite populations may build up rapidly. If the field average score is equal to or greater than three and injury is found throughout the field, chemical control is recommended. If the field average score is lower than three but drought condition persists, scout the field every 4-5 days.

Some pyrethroid insecticides have been shown to aggravate mite infestation. Pyrethroids may kill two-spotted spider mites natural enemies or perhaps even boost the mite's reproduction rate. Thus, pyrethroid insecticide application should be followed up with mite scouting within 10-14 days of application (Chapter 35, Table 35.2).

Description, Biology, and Management of Grasshoppers

Two species of grasshoppers are common on soybean: the red-legged grasshopper *(Melanoplus femurrubrum)* and the differential grasshopper *(Melanoplus differentialis)*. Other species of grasshopper may also occur on soybean, albeit less commonly.

Description of grasshoppers

Both red-legged and differential grasshoppers lay their eggs as elongated egg pods about 0.5-2 inches below the soil surface. A red-legged grasshopper egg pod contains 25-30 eggs while a differential grasshopper egg pod contains 50-150 eggs. When grasshopper eggs hatch, nymphs emerge. Grasshopper nymphs are similar to adults in shape, but smaller with undeveloped wings. Depending on the developmental stage, the nymphs of both grasshopper species range between 0.15 and 1.25 inches in length.

A characteristic broad pale band runs on each side of the head of red-legged grasshopper nymphs. The band starts around the gena (cheek area) and runs backward crossing the side of the thorax (main body trunk) through the first segment of a nymph's abdomen (Fig. 37.5). A similar band runs on each side of the thorax of differential grasshopper nymphs. On differential grasshopper nymphs, the band does not start around the gena, but directly behind the head.

Figure 37.5. A red-legged grasshopper nymph (*Melanoplus femurrubrum*). Notice the pale band starting on the side of the head and crossing the thorax. (Photo courtesy of Joseph Berger, Bugwood.org)

Figure 37.6. Adult red-legged grasshopper (*Melanoplus femurrubrum*). Notice the red hind leg. (Photo courtesy of Russ Ottens, University of Georgia, Bugwood.org)

Figure 37.7. Adult differential grasshopper (*Melanoplus differentialis*). Notice the stark, black, v-shaped markings on the hind leg. (Photo courtesy of David Riley, University of Georgia, Bugwood.org)

Figure 37.8. Defoliation from grasshopper feeding. (Photo courtesy of Clemson University - USDA Cooperative Extension Slide Series, Bugwood.org)

Adult red-legged grasshoppers are 0.9-1.3 inches long with reddish brown upper body color, a bright yellow underside and characteristic red hind legs (Fig. 37.6). Adult differential grasshoppers are 1.1-1.7 inches long with yellowish brown color and distinct v-shaped black markings on the hind legs (Fig. 37.7).

Grasshopper biology and feeding

Female grasshoppers lay eggs in the soil during summer to mid-fall. Undisturbed grassy sites, including field borders, roadsides, prairie and pastures, are among the preferred egg-laying sites. Following an outbreak year, grasshopper eggs are also found in cultivated sites such as alfalfa, clover, and soybean fields. Grasshopper eggs hatch the following spring. Because female grasshoppers lay their eggs in a scattered manner, each egg pod may be exposed to a unique set of soil temperature and moisture conditions. As a result, the timing of the egg hatch may be extended to several weeks or even months and grasshopper nymphs may be evident in the field throughout summer.

Typically, red-legged grasshopper nymphs are found in the field 1-2 weeks earlier than differential grasshopper nymphs. The nymphs molt 4-5 times, becoming larger each time, to become a fully developed adult. Red-legged grasshopper nymphs take about 40 days to develop into adults while differential grasshopper nymphs-to-adults development take about 32 days. Adult red-legged grasshopper may disperse, but most stay nearby the hatching eggs and feed on available plants. In contrast, both nymph and adult differential grasshoppers move actively in search of green tissue. Adult differential grasshoppers are strong flyers and their populations grow well on soybean, sunflower, and wheat.

Weather is a key factor driving the grasshopper population highs and lows. Low rainfall is associated with high rates of egg laying and survival, encouraging high initial grasshopper populations the following year. Two or more consecutive drought years may lead to a grasshopper outbreak. Early hard freeze in the fall may disrupt the egg-laying period by killing adult grasshoppers. Warm humid weather, for an extended period, may stimulate a disease outbreak and a reduction in the grasshopper population.

Grasshoppers are occasional pests of soybean. Both nymphs and adult grasshoppers feed on soybean leaves and pods. Defoliation is usually most severe in late summer, when the adult grasshopper population is the highest (Fig. 37.8). Grasshoppers can also chew through pod walls to feed on soybean seeds, directly reducing yield. Additionally, grasshopper-chewed pods are prone to secondary fungal infection.

Chemical and cultural management of grasshoppers

Scouting for grasshopper-inflicted injury should start early in the growing season to determine the incidence and extent of grasshopper problems. This time period coincides with nymph emergence from soil. Economic thresholds are based on defoliation percentage estimate of the field. Chemical control is recommended when defoliation in the field exceeds 40% pre-bloom, or exceeds 20% between blooming and pod fill. The details of scouting for defoliation percentage are described in Chapter 36. Some of the insecticides labeled for grasshoppers are listed in Table 35.2 in Chapter 35 on soybean aphids.

Tillage and small grain stubble has a mixed impact on grasshopper populations. Tillage of small grain stubble deters egg-laying by adult grasshoppers, while tillage after eggs are laid is ineffective since it does not cause sufficient egg mortality.

Description and Biology of Caterpillars

A number of caterpillars invade soybean plants. Among these, green cloverworm *(Plathypena scabra)*, armyworms and woolly bears are relatively common in South Dakota soybean, though they do not frequently reach economically important levels.

Cloverworms

Description of green cloverworm

Fully grown green cloverworms are about one inch long, pale green with two white stripes along each side of the body (Fig. 37.9). The green cloverworm has three pairs of prolegs (fleshy legs apart from the three pairs of true legs near the head) in the middle of the body and a pair of prolegs at the back end of the body. Green cloverworm wiggle vigorously when disturbed. The adult moth of green cloverworm has a wingspan of about one inch. The female moth has charcoal-colored wings with brown and silver patches, while the male moth wings are more uniformly charcoal in color.

Figure 37.9. Green cloverworm on soybean. Notice the white line on the body side, three pairs of prolegs in the middle of the body, and a pair of prolegs in the hind end of the body. (Photo courtesy of Clemson University - USDA Cooperative Extension Slide Series, Bugwood.org)

Biology of green cloverworm

The green cloverworm overwinters in the southern states of the U.S. and migrates to South Dakota in spring. Migrating moths arrive in early June and mated female moths lay eggs singly on the underside of soybean leaves. After 3-4 days, the eggs hatch and the green cloverworms start to feed on the leaves. In about 14 days, green cloverworms develop through six instars (growth stages). Most of the leaf feeding occurs when the cloverworms are in the 4th to 6th instars. Mature green cloverworms burrow into the soil or plant debris to pupate. Seven to ten days after pupation, the adult moths emerge, mate and lay eggs. The green cloverworm typically produce two generations in the South Dakota, but cannot overwinter here.

The green cloverworm feed on leaf tissues between the main veins. Early instar larvae scrape leaf tissues creating a transparent skin on the leaf surface. Feeding by mature larvae produces holes on the leaves. A green cloverworm is estimated to consume 8.5 in^2 of soybean leaf throughout its life. The green cloverworm population only occasionally reaches economically damaging levels on soybean in South Dakota. Outbreak years are usually associated with an unusually high number of migrants from the southern states.

Figure 37.10. Fall armyworm caterpillar. Notice the prominent Y-shaped marking on the head. (Photo courtesy of Steve L. Brown, University of Georgia, Bugwood.org)

Armyworms

There are three species of armyworms commonly found on soybean: fall armyworm, *Spodoptera frugiperda*; beet armyworm, *Spodoptera exigua*; and yellowstriped armyworm, *Spodoptera ornithogalli*. All armyworms are general herbivores, capable of infesting many crops and vegetables. Armyworms feed on both leaves and pods of soybean.

Description of armyworms

Fall armyworms have a prominent white inverted Y-shape on the head (Fig. 37.10). Additionally, four dark spots are usually visible on the upper side of the caterpillar's eight abdominal segments.

Beet armyworms are green to black in color with a black spot on each side of the second segment of the thorax or chest-area. Unlike the fall armyworm, the beet armyworm body is smooth with fewer hairs or spines and the head bears no prominent Y-shaped marking (Fig. 37.11). Yellowstriped armyworm caterpillars are usually dark with a yellow or light colored bands running along the body sides (Fig. 37.12). A black spot can usually be seen on each side of the first abdominal segment.

Figure 37.11. Beet armyworm (*Spodoptera exigua*). (Photo courtesy of Frank Peairs, Colorado State University, Bugwood.org)

Figure 37.12. Yellowstriped armyworm (*Spodoptera ornithogalii*). (Photo courtesy of Clemson University - USDA Cooperative Extension Slide Series, Bugwood.org)

Armyworm biology

Fall armyworms overwinter in southern states and migrate northward in spring and summer. At a constant temperature of 77°F, there are about 31 days between egg hatch and adult emergence. Cooler temperatures typically slow the fall armyworm development. In South Dakota, there is one generation of fall armyworms produced in a year.

Similar to fall armyworm, beet armyworms cannot withstand South Dakota winters and spend the winter in southern states, migrating northward in spring and summer. One to two generations of beet armyworm are produced annually in South Dakota.

The yellowstriped armyworm life cycle requires 23-25 days to complete, although in cooler climates it may take a month or more. Typically, three generations per year of yellowstriped armyworm are produced in South Dakota.

Fall armyworm caterpillars infesting seedling soybean may cut the stems and reduce the crop population below the optimal level. In their early life stages, beet and yellowstriped armyworms feed in groups, producing skeletonized leaves with the fleshy leaf tissues eaten and the leaf veins intact. As the caterpillars mature, they disperse and the resulting patches of leaf defoliation become more irregular.

Armyworms are an occasional pest of soybean. Soybean is capable of compensating foliage loss, especially if it happened before flowering. However, high level infestation and resulting severe defoliation damage can retard further plant growth.

Woolly Bear Caterpillars

Description of woolly bear caterpillars

Woolly bear caterpillars are larvae of various moths from the family Arctiidae. These caterpillars are generalists, feeding on broadleaf weeds and various vegetables including beans, beets, cabbage, carrots, celery, lettuce, tomato and many others. The caterpillars are generally characterized by numerous elongated hairs (setae) protruding from the body. The hairs are typically bunched on fleshy warts on the surface of the caterpillar's body.

While there are multiple species of woolly bear caterpillars that feed on soybean, the yellow woolly bear caterpillar, *Spilosoma virginica*, is quite common on South Dakota soybean. The yellow woolly bear ranges from white to yellow and reddish in color, about 0.19 inch long and densely covered with long and short hairs of uniform color (Fig. 37.13). The adult moth of yellow woolly bear caterpillar is nearly pure white except for the abdomen. The wings are white with a few black spots.

Figure 37.13. Yellow woolly bear caterpillar (*Spilosoma virginica*) on soybean. (Photo courtesy of Nita Sari Dewi)

Biology of woolly bear caterpillars

Yellow woolly bear caterpillars overwinter as pupae inside thick silken cocoons heavily covered with hairs from the caterpillar body. The adult moths emerge from the cocoons in spring and lay their eggs in clusters on the underside of host leaves. After eggs hatch, caterpillars feed until pupation. Egg hatch to pupation takes anywhere between one and two months. Typically, two generations of yellow woolly bear caterpillar are produced in South Dakota.

Young caterpillars feed gregariously on the tissues between leaf veins, skeletonizing the leaves at high infestation levels. The mature caterpillars feed alone on more exposed sites and may chew sizable holes in the leaves. The population of these caterpillars is easily overestimated due to the striking appearance of the caterpillars and the conspicuous injuries the mature larvae inflict on plants (Fig. 37.14).

Figure 37.14. Injuries due to yellow woolly bear caterpillar (*Spilosoma virginica*) feeding on soybean. (Photo courtesy of Darrell Mueller, Iowa State University)

Management of Caterpillars in Soybean

In seedling soybean, examination of whole plants in rows is the best method to scout for armyworm injury. Cut seedling stems may be a hint that fall armyworms are present. Fall armyworm treatment in seedling soybean is warranted if the number of cut stems reduces the plant population below the recommended stand density.

In older soybean, the injury inflicted by the caterpillars discussed above and other leaf feeders (e.g., soybean looper, bean leaf beetle, and grasshoppers) is assessed accumulatively in terms of the proportion of leaf lost to defoliating pests (Chapter 36). The field scouting method to estimate average field defoliation rate is provided in Figure 36.4. Management action is recommended if defoliation reaches 40% in pre-bloom and 20% during bloom and pod-fill. Some of the pesticides labeled for these caterpillars are listed in Table 35.2 in Chapter 35 on soybean aphids.

References and additional information

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Websites

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