Bean Leaf Beetle Management in Soybeans

CROP BULLETIN

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SUMMARY

- Bean leaf beetle is a pest of soybean in most soybean growing regions of the United States. There may be three generations in the southern U.S., two generations in the central Corn Belt (Nebraska, Iowa, Illinois), and only one generation in the northern Corn Belt.
- Adults feed on cotyledons, leaves, and the external surface of pods. Larvae feed underground on nodules and roots.
- Adult bean leaf beetles also can transmit a soybean pathogen—bean pod mottle virus—which causes "stay green" and delays soybean maturity.
- Following mild winters, which contribute to higher than average survival, bean leaf beetle populations can reduce plant populations by feeding on newly-emerging soybeans, especially in early-planted fields.
- During vegetative growth from the V2 stage to flowering, soybeans can tolerate from 40% to 60% defoliation without yield loss. Bean leaf beetles rarely, if ever, cause this degree of defoliation.
- Second-generation beetles usually peak during soybean pod-fill stages, resulting in injured pods. Yield loss can occur at this time (usually during August in Midwestern states).
- Scouting regularly for bean leaf beetle and spraying, if necessary, is recommended to address this problem insect. A new strategy to treat second generation beetles based on first generation beetle numbers has been proposed.

IDENTIFICATION AND LIFE CYCLE

Adult bean leaf beetles are approximately 1/4 inch in length, and vary in color (dull yellow, orange, tan, or red) and markings. Usually the wing covers have four "large" black spots and distinct black margins, but these are absent in some beetles. However, all bean leaf beetles have a black triangle just behind the head (Figure 1). Larvae resemble corn rootworm larvae: slender, cream colored, and dark head but with a dark brown shield at the tip of the abdomen.

Figure 1. Bean leaf beetles vary in color, but adults always have a black triangle at the base of the wing covers; usually there are four large spots (L), but these may be absent (R).

Bean leaf beetles hibernate (i.e., overwinter) as adults beneath plant debris in woods, grassy areas and cropland. When spring temperatures reach 50-55°F, adults become active and seek host plants, such as alfalfa, clover, and certain weeds. When soybeans emerge, these overwintered beetles may move to soybean fields to feed and lay eggs. Females lay 130-200 eggs, and these will hatch in about one week at a soil temperature of 82°F.

Larvae remain in the soil, feeding on soybean root hairs and nodules. The effect of this feeding is largely unknown but is generally considered not to cause yield loss. Time of development from egg to adult depends on soil temperature; 674-740 degree days are required at a base threshold of 46°F.

Pupation occurs in earthen cells below the soil surface. Adults, comprising the first generation, emerge about a week later, usually in July in Midwestern states. This cycle is repeated, and a second generation of beetles will emerge in late August or September. As soybeans reach maturity, this second generation exits the fields to alternate hosts and eventually enters hibernation (i.e., overwintering) sites.

Bean leaf beetles overwinter in woodland leaf litter, grassy fencerows, and under heavy soybean debris, and their survival is highly dependent on winter temperatures. Researchers at Iowa State University determined that winter survival can be predicted by a model that uses accumulated daily average subfreezing temperatures from Oct. 1 to April 15 (Lam and Pedigo, 2001). This model shows that beetle survival averages about 30% in Iowa over the long term but can be greater, such as in the winter of 2001-2002 that averaged 52% (Rice and Pope, 2002). Survival of the overwintered beetles strongly influences subsequent problems throughout the growing season.

FEEDING ON SOYBEANS

Bean leaf beetles possess chewing mouth parts and feed on soybean plants at all stages of crop development. When overwintering populations are high, newly-emerged soybean stands can be reduced by beetles feeding on cotyledons and the growing point (Figure 2). The first-generation beetles feed primarily on soybean leaves while the second-generation beetles feed on leaves and pods.

Figure 2. Bean leaf beetle feeding injury to soybean hypocotyl (left) and cotyledons (right).

Leaf feeding by the bean leaf beetle can be identified by small round holes between the veins. Although leaf feeding injures the plants, soybeans can withstand a surprising amount of defoliation without incurring economic losses. In the vegetative stages, soybeans can usually sustain 50% leaf area loss without economic yield reductions.

Bean leaf beetles do not feed directly on soybean seeds, but they reduce soybean seed yield and quality by feeding on the pods. Occasionally, entire pods may be clipped when feeding occurs at the base of the pod. During a drought year, beetles were observed to clip pods at a rate of 0.125 pods per beetle per day (Smelser and Pedigo, 1992). Beetles frequently consume the outside layer of pod tissue, leaving a thin layer still covering the seed. Moisture and diseases can enter the pod through this lesion. Secondary infection by fungal pathogens, such as Alternaria, results in shrunken, discolored, and moldy seeds.

The Virus Connection

The bean leaf beetle is also a vector of several soybean viruses, including yellow cowpea mosaic, cowpea chlorotic mottle, southern bean mosaic, and bean pod mottle virus. Bean pod mottle has been identified at increasingly high levels in Illinois, Iowa, and other major soybean-producing states. This virus can reduce yields 10-15% and by much more in combination with other viruses.

Bean pod mottle virus causes mottling and distortion of the upper soybean leaves. The crinkled leaves and stunted plants can resemble injury from herbicide drift or soybean mosaic virus. Death of new terminal leaf growth may also occur. The virus also gives rise to “green stem” symptoms in some soybean plants. Affected plants do not mature normally, and stems remain green throughout the harvest period. (However, factors other than viruses are implicated in green stem syndrome as well.)

Bean pod mottle virus may also affect the seed, causing a light purplish discoloration of the seed coat. Seed mottling may also occur, resulting from pigments diffusing from the hilum of the seed. Yield reductions of 3–52% may occur depending on the soybean variety and the time of infection (see Hadi et al., 2012 for a detailed discussion).

Scouting and Management for Feeding Injury

Bean leaf beetles are present throughout the soybean growing season, so all crop stages from emergence to R7 are exposed to feeding, additionally the beetles also transmit several viruses. This management section will focus on feeding injury only, and virus control will be addressed at the end.

Emerging Soybeans Through V2 Stage

Just-emerged soybeans are at risk for significant feeding injury when beetle populations are high, especially when planted early and emerging first in an area. The period from emergence through establishment of the first trifoliolate leaf is one of the most critical for soybean damage. If the cotyledons (seed leaves) are destroyed before the unifoliolate leaves fully emerge or if the growing point is severely damaged, stands and yields may be reduced.

Scouting of bean leaf beetles on just-emerged soybeans is done by direct observation, as beetles are easy to see and count at this stage. Each state has developed its own treat-

Table 1. Economic thresholds for bean leaf beetles in early-stage soybeans (Hunt et al., 1995; Rice et al., 2005).

Soybean Market Price	Soybean Growth Stage / Cost of Treatment ($/acre)											
	VC				V1				V2			
	$6	$10	$14	$18	$6	$10	$14	$18	$6	$10	$14	$18
$/bu	——— beetles/plant ———				——— beetles/plant ———				——— beetles/plant ———			
5.00	2.5	4.1	5.8	7.4	3.8	6.3	8.9	11.4	6.0	9.9	13.9	17.9
10.00	1.2	2.1	2.9	3.7	1.9	3.2	4.4	5.7	3.0	5.0	7.0	9.0
15.00	0.8	1.4	1.9	2.5	1.3	2.1	3.0	3.8	2.0	3.3	4.6	6.0

ment thresholds for bean leaf beetle feeding at various stages of crop development. Recommendations from Iowa and Nebraska are shown in Table 1.

Once the trifoliolate leaves have unrolled, soybeans can tolerate from 40 to 60% defoliation without yield loss. Scouting may be done by direct observation at V2 or V3, but this method will become impractical as canopy development progresses. At this point, use of a drop cloth or sweep net is necessary. Scouting procedures and treatment thresholds vary by state; check your state's publications, website, or extension entomologist's recommendations.

Soybeans in Reproductive Stages

Both the first and second generations may feed on soybeans during reproductive development. The first generation populations usually peak in the late vegetative and early reproductive soybean stages. Feeding at this time seldom causes economic losses.

The second generation usually peaks during pod-fill stages, resulting in injured pods. It is essential to scout fields regularly for bean leaf beetles at this time. Management decisions are based on beetle densities, which can change rapidly. During times of bean leaf beetle activity, fields should be scouted every 5-7 days. Counts can be stopped when any of the following conditions apply:

1. Beetle populations start to decline.
2. Soybean pods begin to turn yellow (R7 stage).
3. The field is sprayed.

For scouting at this time, entomologists recommend using a drop cloth between soybean rows, shaking the soybeans vigorously, and counting the beetles as they hit the cloth. A sweep net can also be used and is recommended by some entomologists for narrow-row soybeans. When using the sweep net, sweeping technique is important for accurate sampling and use of economic thresholds. Below are economic thresholds from Iowa State University (Table 2; Rice, 2000).

Figure 3. Bean leaf beetles and feeding injury to young soybeans.

New Control Strategy Proposed

Second generation bean leaf beetles may feed on pods for several weeks before population densities reach the economic threshold. In such situations, some loss of yield and quality is inevitable prior to insecticide application. A new approach that would attempt to prevent such damage before it occurs has been proposed by Iowa State University (Hadi et al., 2012) This system is radically different from other management approaches that use economic thresholds. The new concept is to sample first-generation beetle density and use this information to make management decisions regarding the more damaging second generation. This strategy requires the use of degree days from planting as well as weekly sampling to time a possible insecticide application. (Details of this dynamic strategy may be found in the link in the references.)

Table 2. Bean leaf beetle economic thresholds in reproductive stage soybeans.*

Soybean Price ($/bu)	Treatment Cost per Acre (Insecticide + Application)								
	$7	$8	$9	$10	$11	$12	$13	$14	$15
	beetles per foot of row								
$5.00	5.5	6.3	7.1	7.9	8.7	9.5	10.3	11.0	11.8
$6.00	4.6	5.2	5.9	6.5	7.2	7.8	8.5	9.2	9.9
$7.00	3.9	4.4	5.0	5.6	6.1	6.7	7.3	7.8	8.4
$8.00	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5
	beetles per sweep								
$5.00	3.5	4.0	4.5	5.0	6.5	7.2	7.7	8.3	8.7
$6.00	2.9	3.3	3.7	4.1	5.4	6.0	6.4	6.9	7.3
$7.00	2.4	2.8	3.1	3.5	3.8	4.2	4.5	4.9	5.2
$8.00	2.2	2.5	2.8	3.2	4.1	4.5	4.8	5.2	5.5

*Economic thresholds are based on a row spacing of 30 inches and a plant population of 8 plants per ft. of row. For narrow-row soybeans (8-inch rows) and a plant population of 3 plants per ft. of row, multiply the above economic thresholds by 0.7.

Table 2. Bean leaf beetle economic thresholds in reproductive stage soybeans.*

Trade Name	Chemical Name	Product Rate per Acre	Pounds A.I. per Acre	Pre-Harvest Interval
Asana® XL 0.66EC	esfenvalerate	5.8 – 9.6 oz.	0.03 – 0.05	21 days
Baythroid® XL 1EC	beta-cyfluthrin	1.6 – 2.8 oz.	0.0125 – 0.022	45 days
Brigade® 2EC	bifentrhin	2.1 – 6.4 oz.	0.033 – 0.10	18 days
Karate® Z 2.08CS	lambda-cyhalotrhin	0.96 – 1.6 oz.	0.015 –0.025	45 days
Larvin® 3.2F	thiodicarb	18 – 30 oz.	0.45 – 0.75	28 days
Mustang® Maxx 0.8EC	zeta-cypermethrin	2.8 – 4 oz.	0.0175 – 0.025	21 days
Orthene® 90S	acephate	0.83 – 1.1 lb.	0.75 – 1.0	14 days
Prolex™ 1.25EC	gamma-cyhalothrin	0.77 – 1.28 oz.	0.0075 – 0.0125	45 days
Sevin® XLR 4L	carbaryl	1 – 2 pt.	0.5 – 1.0	21 days

**Some insecticides are restricted use. Read and follow all label directions.

MANAGING BEAN POD MOTTLE VIRUS

Growers who have had bean pod mottle virus symptoms in their fields in recent seasons (particularly green stem syndrome) may be concerned about controlling this soybean virus. However, much about the relationship between the beetle, the virus, and soybeans remains unknown. It is commonly known that the earlier soybeans are infected, the greater the potential reduction in yield.

Delayed soybean planting date has been suggested as a bean pod mottle virus management tactic (Giesler et al., 2002), but a three-year field study in Iowa showed that delayed planting did not consistently result in lower bean pod mottle virus infection (Krell et al., 2005).

Soybean seed treatment for overwintered bean leaf beetle or foliar pyrethroid insecticides between emergence and first trifoliolate reduces total bean pod mottle virus incidence, likely by protecting soybean seedlings from early beetle populations (Krell et al., 2004; Bradshaw et al., 2008). Additional applications of foliar insecticides by using foliar pyrethroid insecticides midseason (around blooming) aimed at controlling the first generation of bean leaf beetle may further suppress virus incidence (Krell et al., 2004; Bradshaw et al., 2008).

INSECTICIDES FOR BEAN LEAF BEETLES

A variety of insecticides are registered for bean leaf beetle in soybeans (Table 3). Effective insecticides should have good initial knockdown as well as residual control; consult your state university extension entomologist for details. Growers should also consider the pre-harvest interval when selecting an insecticide. Some insecticides have intervals of 21 days or less, but others have 45 day pre-harvest intervals.

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