Bean Leaf Beetles in South Dakota

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Introduction

Bean leaf beetles, *Cerotoma trifurcata* (Forster) (Coleoptera: Chrysomelidae), are native insect pests that feed on soybean. The adult beetles can cause extensive defoliation injury to host plants (Hadi et al. 2012). The host range of bean leaf beetles includes leguminous plants, nettles, and cucurbits (Helm et al. 1983, Koch et al. 2004, Hadi et al. 2012). Bean leaf beetles are an issue for cultivated crops like soybean and alfalfa as well as in gardens where they are often observed on green beans (Helm et al. 1983, Hadi et al. 2012). In South Dakota, the economic importance of bean leaf beetles varies from year to year. This is due to the fluctuation of overwintering mortality caused by temperatures falling below 14 °F (Lam and Pedigo 2000). Each spring, extension entomologists at South Dakota State University provide an estimate of bean leaf beetle mortality based on the accumulated cold temperatures for numerous locations across the state. Although the calculated values are not 100% accurate, the goal is to provide an estimate of where overwintering bean leaf beetle populations are likely to be an issue.

Biology of the Bean Leaf Beetle

Appearance

Adults are the most observed life stage of bean leaf beetles. These beetles are approximately 0.25 of an inch long and can typically be identified by the four markings on the elytra (hardened forewings covering the abdomen) that are square-shaped (Figure 1). However, there are instances of variation where there are only two markings, or the markings may be completely absent (Hadi et al. 2012). In addition to variations in the presence of markings, the color of adult bean leaf beetles can vary within a field (Hadi et al. 2012). Bean leaf beetles can range in color from light tan, brown, orange, to red (Figure 2) (Hadi et al. 2012). All color forms have a black triangle referred to as the scutellum just behind the head, which is always present regardless of other marking variation (Pedigo 1994). Male and female bean leaf beetles can be differentiated from one another by the color of their frons (face). Female beetles have a black frons, whereas the males have a light brown frons (Hadi et al. 2012).

Figure 1. Adult bean leaf beetle depicting the black triangle located behind the pronotum and the four black square shaped markings on the elytra. Photo courtesy of Adam Varenhorst.

Figure 2 A. Light tan Bean Leaf Beetle. Photos courtesy of Adam Varenhorst

Figure 2 B. Red Bean Leaf Beetle.

Figure 2 C. Yellowish-Orange Bean Leaf Beetle.

The eggs of bean leaf beetles can be found in small clusters in the soil at the base of host plants (Hadi et al. 2012). The eggs are oval shaped and orange in color (Hadi et al. 2012). Bean leaf beetle larvae are segmented and white in color with a brown head and brown plate on the last segment of the abdomen (Figure 3) (Hadi et al. 2012). Fully grown larvae are approximately 0.4 of an inch long (Hadi et al. 2012). The pupae of bean leaf beetles are white and are found in the soil (Hadi et al. 2012).

Figure 3. Bean leaf beetle larvae. Photo courtesy of Jeff Bradshaw, University of Nebraska.

Life Cycle

Bean leaf beetles overwinter as adults under crop residues in soybean fields or under leaf residue in wooded areas (i.e., groves or shelter belts) near previous soybean fields (Hadi et al. 2012). In South Dakota, bean leaf beetles may have one to two generations per season after the emergence of the overwintering adults based on the latitude of the field (Hadi et al. 2012).

Survival of overwintering bean leaf beetles decreases when they are exposed to temperatures below 14 °F (Lam and Pedigo 2000). Overwintering mortality decreases when the adults can find suitable protection from the cold temperatures (e.g., wooded overwintering sites tend to be warmer than harvested fields) and there is adequate snow cover to serve as an insulator (Lam and Pedigo 2000).

The adult bean leaf beetles that do survive the winter begin emerging as early as mid-May or early June or when air temperatures reach 50-55 °F (Loughran and Ragsdale 1986). This generation is referred to as the overwintering generation. After emerging, the beetles will mate and disperse to alfalfa if no soybean have emerged (Hadi et al. 2012). The adults move to soybean once seedlings begin to emerge (Hadi et al. 2012). Once they have found a host to feed on, they mate and females lay their eggs within the first two inches of soil around the base of soybean plants (Koch et al. 2004). Females can lay eggs in clusters ranging from 12 to 250 eggs per cluster (Loughran and Ragsdale 1986, Koch et al. 2004). The number of eggs laid per cluster depends on location of the field (Hadi et al. 2012). Fields in northeastern South Dakota will have fewer eggs than those laid in southeastern South Dakota. The egg hatch depends on temperature and will vary from one to three weeks (Loughran and Ragsdale 1986). The warmer the weather, the faster the eggs will hatch into larva.

Newly hatched larvae will feed on the soybean roots and root nodules. This feeding causes minimal damage and little to no yield loss (Loughran and Ragsdale 1986). There are six instars that the larvae go through before pupating (Pedigo 1994). Temperature plays a large role in how fast these insects develop in all stages of their life cycle. The warmer the temperature, the faster the larvae will pupate (Loughran and Ragsdale 1986). When soil temperatures are cooler, pupation may take up to three weeks (Loughran and Ragsdale 1986).

The first-generation adults then begin emerging from the soil usually in July and will continue to emerge until August in South Dakota. The bodies of the adults stay soft for a short time until their exoskeleton can harden after they emerge (Pedigo 1994). In South Dakota, there is likely a single generation during the summer (Loughran

and Ragsdale 1986). The first-generation adults will continue feeding until they overwinter in other plant debris in surrounding areas, and the cycle starts again in the following spring.

Plant Injury

The overwintering bean leaf beetles will feed on the cotyledons and leaves of the soybean during the early vegetative growth stages, which can reduce yields by approximately 12% (Hunt et al. 1994). This is more likely to occur with larger population densities of the overwintering generation and can result in reduced stand counts (Loughran and Ragsdale 1986). Although economic losses aren't well documented for the larvae, it is documented that they feed on the root nodules and decrease nitrogen fixation and total nitrogen present in the shoots (Lundgren and Riedell 2008).

Bean leaf beetle defoliation appears as small shot holes on the leaves (Hesler et al. 2018) (Figure 4). The overwintering generation will feed on plants for roughly one month, and each day they are able to consume 0.384 to 1 cm^2 of leaf and plant tissue (Pedigo 1994). The first-generation adults will feed on the leaves and the developing pods (Hadi et al. 2012). The bean leaf beetles do not feed directly on the soybean seeds but do reduce seed quality by consuming the outermost layer of pod tissue leaving a thin layer to surround the seeds (Hadi et al. 2012). If adults feed near the base of the pod, clipping of the pod may occur (Loughran and Ragsdale 1986).

Figure 4. Defoliation injury caused by adult bean leaf beetle feeding. Photo courtesy of Adam Varenhorst.

In South Dakota, the overwintering bean leaf beetle populations can cause defoliation injury to soybean shortly after emergence. The first-generation causes defoliation during flowering and seed set. During the vegetative stages, soybeans can tolerate substantial defoliation (Hadi et al. 2012). Management is recommended when approximately 30% defoliation of the leaf tissue has occurred during the vegetative stages and 20% defoliation during the reproductive stages.

Vectored Plant Diseases

Bean leaf beetles are known to vector plant viruses to soybean in South Dakota (Loughran and Ragsdale 1986). These viruses include bean pod mottle virus (BPMV), cowpea mosaic virus, cowpea chlorotic mottle virus, and southern bean mosaic virus (Boethel 2004). Virus transmission occurs when a bean leaf beetle carrying the virus feeds on healthy plant tissue (Boethel 2004). Of these viruses, BPMV is the most economical and widespread in major soybean production areas (Giesler et al. 2002). Depending on the time of infection, BPMV can reduce yields from 3%-52%, with early season infections resulting in greater yield loss (Gergerich and Domier 2015). Bean pod mottle virus infections reduce pod size and number, seed size and test weight (Gergerich and Domier 2015). Symptoms to monitor BPMV infections include distortion of the upper leaves (Figure 5), crinkled leaves, stunted plants, mottling with puckering leaflets, and mottling of pods as well as seed coats (Figure 6) (Hadi et al. 2012) Discolored seeds will have a light purple to dark purple discoloration (Hadi et al. 2012). The symptoms may vary depending on soybean variety, stage of growth when inoculated, and planting date (Pedigo 1994). Plants that are infected at earlier growth stages do not mature normally. The virus is also known to give rise to green stem which causes stems to remain green through the harvest season (Hadi et al. 2012).

Figure 5. Bean pod mottle virus leaf symptoms. Photo courtesy of Connie Strunk.

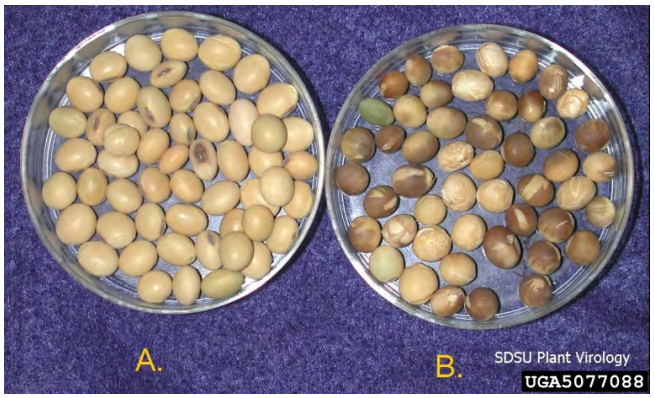

Figure 6. Bean pod mottle virus negative (left) and positive (right). Infected seeds with discoloration of the seed coat. Photo courtesy of Connie Strunk.

Scouting

Shortly after soybean emergence, fields should be monitored for bean leaf beetle activity. When soybeans are at the VE to V3 growth stages using a sweep net is not recommended as it may injure the plants. At this time, examine 10 plants from five locations throughout a field for defoliation or the presence of bean leaf beetle adults. If bean leaf beetles are observed and there is a history of BPMV in the area, the populations should be managed with insecticides. Scouting should focus on fields that were planted without an insecticide seed treatment. Fields should be scouted using a sweep net from July through August.

Management

Early season management of bean leaf beetles has been shown to reduce defoliation and the transmission of BPMV. Insecticide seed treatments are considered effective against bean leaf beetles. In the absence of a seed treatment, a foliar insecticide application should be considered between emergence and the first trifoliate stage (V1). If the first generation is above threshold, a foliar insecticide application should be considered (Bradshaw et al. 2008).

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