Soybean Gall Midge in South Dakota

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Introduction

In 2019, the soybean gall midge, *Resseliella maxima* Gagné (Diptera: Cecidomyiidae) was determined to be a new species of gall midge that it is capable of infesting soybean (1). The first observation of soybean gall midge in the Midwest was reported in northeastern Nebraska in 2011, and it was first observed in southeastern South Dakota in 2015 (2, 3). The initial observations of soybean midge were only in soybean with previous mechanical injuries (e.g., bruising from hail stones) and it appeared that the larvae were feeding on a white saprophytic fungus that was also present under the epidermis (Figure 1). During the 2011 and 2015 observations, there were no indications that soybean gall midge larvae were actively feeding on the soybean plant (2, 3). Since the initial observations of benign populations, the soybean gall midge has rapidly transitioned to an economically important pest capable of causing extensive lodging (4). In addition, the soybean gall midge can reduce soybean yields by 20-100 % along field margins with reductions of entire field averages ranging from 17-50%, depending on the severity of infestation (4). To date, the soybean gall midge has been observed in 114 counties across five states (i.e., Iowa, Minnesota, Missouri, Nebraska and South Dakota) (Figure 1) (4).

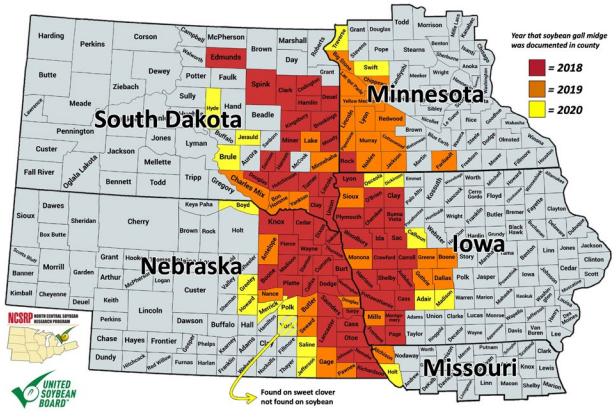

Figure 1. County map of soybean gall midge infestation. A total of 111 counties have had soybean gall midge detected in five states. To date, soybean gall midge has been confirmed in 26 counties in South Dakota. Red counties had positive identification of soybean gall midge infested soybean in 2018, orange counties in 2019 and yellow counties in 2020. Map courtesy of Justin McMechan, University of Nebraska.

Biology of the Soybean Gall Midge

Life Cycle: Soybean gall midge undergo complete metamorphosis, which includes the egg, larva, pupa and adult life stages. Recent research suggests that gradual adult emergence begins in the spring (April and May) and continues for several weeks. Once emerged and mated, it is hypothesized that female soybean gall midge lay eggs on the soybean stem in areas where previous injury or wounding has occurred (i.e., hail stone injury, growth splits in epidermis, mechanical

injury). Direct observation of this behavior has not yet been observed. However, soybean gall midge larvae are only observed under the epidermis near injured areas of the stem. After hatching, the larvae enter the plant through the injured areas of the epidermis and establish a feeding site. The majority of infestations are observed near the surface of the soil where splits in the epidermis naturally occur during early vegetative soybean growth stages. Infestations higher on the stem have been associated with injury caused by machinery, wind or hail. Larvae feed and develop under the epidermis of soybean where populations may range from very few to several hundred.

The time between generations and the number of generations that occur each season are currently unknown. However, it has been determined that there is more than one generation each season with the generations overlapping. In the fall, larvae move from the soybean plants to the soil where they overwinter in silken cocoons (4, 5, 6). Large populations of these cocoons were observed when soil sampling was performed in soybean stubble during the fall of 2018 (4). In the spring, larvae pupate and then emerge as adults. Many factors involved with soybean gall midge biology are still unknown.

To date, soybean gall midge adults have been observed from May through July. Adult emergence happens after the soybean gall midge pupates in the spring. At this time, additional research is required to determine how many generations can occur within a season or how long one life cycle takes to complete. The larvae can be observed in the stems of the soybean plants from the middle of June through September (2, 4). Infestation appears to occur after soybean reach the third vegetative growth stage (V3) and can be observed through the reproductive stages of the soybean plant (2, 4). The adults are noted to be weak fliers and have been observed resting on soybean plants.

Appearance: Adult soybean gall midges are 0.25 inch long (2-3 mm) from the outstretched tip of the front leg to the outstretched tip of the back leg. They can be identified by the alternating black and tan bands present on their legs (Figure 2). The adults also have an orange abdomen and medium length antennae (7).

Figure 2. Soybean gall midge as an adult. Photo courtesy of Justin McMechan, University of Nebraska.

As their name implies, the larvae of the soybean gall midge create a growth (swollen portion of the stem) that is called a gall. In soybean, the gall is typically slight and sometimes difficult to notice. In most fields, the gall is located near the soil surface. The larvae undergo three instars or growth stages that are identified by changes in size and color of the larvae. First instar larvae are nearly clear to white in color and very small (Figure 3). The second instars are pink in color, and the third instars are orange in color and the largest size (Figure 3) (4).

Figure 3. Soybean gall midge larvae. The first instar larva is white and smallest in size, the second instar is light pink and third instar is orange and largest size. Photo courtesy of Adam Varenhorst.

Scouting

Scouting for soybean gall midge should start near the edges of fields. Special attention should be given to soybean fields that border previously infested soybean stubble, groves or shelter belts. Most infestations begin near the edge of the field and move inwards towards the center. Unlike other pests, soybean gall midge infestations are relatively uniform when previously infested areas are nearby (Figure 4).

Figure 4. Figure 4. Damage and yield loss is most substantial in the first 50-100 feet at the outermost edge of the field. Photo by Megan Bierbaum.

Symptoms of infestation include yellowing of the plant, discoloration on the stem, wilting, swelling at a node just above the soil surface, lodging and plant death (Figure 5) (4). When symptomatic plants are observed, peel back the epidermis near the swollen or discolored areas of the stem (Figure 6). If an infestation is present, larvae will often be observed. However, in some cases larvae are not observed but evidence of feeding may still be present.

Figure 5. Discoloration and swelling below the cotyledon node near the soil of the surface are symptoms of soybean gall midge infestation. Photo courtesy of Adam Varenhorst.

Figure 6. Soybean gall midge larvae can be found once the epidermis is peeled up. Photo courtesy of Adam Varenhorst.

In addition to soybean gall midge, the white mold gall midge, *Karshomyia caulicola* (Diptera: Cecidomyiidae) may also be present in late season soybean (Figure 7). In 2019, this species was observed in Minnesota in soybean that were infested by white mold (8). Unlike the soybean gall midge, this species feeds exclusively on white mold and has not been observed feeding directly on soybean. The larvae of the two midge species are similar except that the white mold gall midge tends to be lighter in color and is only present in fields infected with white mold. The white mold gall midge has been observed in and on many areas of the soybean plant.

Feeding and Impact

The larvae are the only stage of the soybean gall midge life cycle that can cause injury to the soybean plant. The impact of the infestation can range from no impact to substantial yield loss depending on the severity of the infestation. It is hypothesized that the feeding and formation of the gall reduces nutrient and water flow, which results in eventual plant death. In addition to direct yield loss, severe lodging has also been observed in soybean gall midge infested fields. The outside 50-100 feet of the field are normally the most heavily infested and have the greatest yield loss. However, infestations have been observed throughout entire fields with entire field yield averages being reduced when fields are heavily infested.

Figure 7. White mold gall midge on soybean. Photo courtesy of Bruce Potter, University of Minnesota.

Management

Currently, no formal management recommendations are in place for soybean gall midge larvae or adults. Observations have been made that later planting dates and higher seeding rates may lead to lower soybean gall midge infestations. The application of foliar insecticides at the onset of adult emergence has also led to reduced infestations, but some soybean gall midge larvae can still be detected in treated fields. Additional work in being done to verify these observations. In addition, research is being conducted to evaluate seed treatments, in-furrow insecticides, foliar insecticides and soybean varieties.

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