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Extension

Corn Leafhopper

The corn leafhopper, *Dalbulus maidis* (Hemiptera: Cicadellidae), is native to tropical and subtropical Central and South America. Although it damages corn directly by removal of plant sap, most economic losses are caused by transmission of various plant diseases, including maize bushy stunt phytoplasma, fine streak virus (maize rayado fino virus, or MRFV), and the causal agent of corn stunt, *Spiroplasma kunkelii*, which may be the most important factor limiting corn production in Central and South America. Recent outbreaks of corn leafhopper in Argentina have resulted in up to 12% of the corn crop being lost to corn stunt, with yield losses estimated at 500 pounds of grain per acre.

Over the past decade, the corn leafhopper has responded to changing climate conditions by expanding its range into more temperate regions of both South and North America, beyond its ancestral range. It was detected in southern Texas in 2016. Its range in the Western Hemisphere as of 2022 is depicted in Figure 1, but such maps are invariably incomplete and require annual updates. It was first recorded in Oklahoma and Kansas, along with corn stunt spiroplasma, in the summer of 2024, a year in which high densities of corn leafhopper were recorded in northern Mexico.

Description and Life History

Immature nymphs vary from translucent yellow to dark brown (Figure 2), whereas adults are pale yellow to beige and about ⅛ to ¼ inch long, with two conspicuous black dots on the top of the head (Figure 3). Adults can live from 30 to 80 days and occur in both wet-season and dry-season forms; the latter can survive several months without access to host plants and are capable of long-distance migrations. Development under cold temperatures results in adults with darker body coloration and larger body size, which are likely adaptations for surviving dry-season conditions of host scarcity.

The corn leafhopper passes through five nymphal instars, and the complete life cycle requires only 25 to 30 days, so two generations can occur within a single corn crop. Females preferentially select young plants for oviposition, each laying up to 600 eggs that are embedded singly in plant tissues where they are protected from contact insecticides. Adults overwinter together with their pathogens, and survival during overwintering is unlikely in temperate latitudes that experience freezing temperatures. However, the longer summers associated with global warming create the potential for a greater number of annual generations, and thus more northerly range expansion in late summer. Although corn leafhopper adults can sustain themselves feeding on a number of grass species, mostly in the family Poaceae, the corn leafhopper only lays eggs on corn, and nymphs are not known to complete development on any other plant species.

Figure 1. Map of the range of the corn leafhopper.
Photo credit: Pozzebon et al., Corn stunt pathosystem and its leafhopper vector in Brazil. 2022. Journal of Economic Entomology, 115(6): 1817-1833.

Corn Stunt Disease

The corn stunt pathogen is transmitted in a persistent-propagative manner, which means that once infected, the corn leafhopper remains infected for life, and the spiroplasma is able to multiply within it. Symptoms of corn stunt appear approximately 30 days postinoculation and vary in accordance with the timing and severity of the infection; only plants infested in early growth stages will be significantly reduced in final height (Figure 4). Later infestations may result in plants with shortened internodes and symptoms of reddening on the leaves (chlorosis) due to interference of sugar translocation by the disease-causing agents (Figure 5).

Although corn leafhopper nymphs can acquire the disease after feeding on infected plants for about an hour, the spiroplasma requires about three weeks to become systemic within the leafhopper, infect the salivary glands, and render the insect infective. Thus, adults, especially females, are the primary vectors, although most acquisition occurs during the nymphal stages. Prolonged periods of feeding by infected leafhoppers (up to several weeks) can be required for successful transmission, although the process is accelerated when many corn leafhoppers feed on the same plant. Once in the plant, the spiroplasma requires anywhere from 10 to 40 days to colonize the vascular system and render it infective. Plants can become sources of infection for corn leafhoppers before any symptoms appear.

Infected leafhoppers have generally shorter lives and reduced fecundity, but infection appears to help them tolerate colder temperatures, which can be critical for overwintering of both the corn leafhopper and the pathogen. Corn domestication has been linked to increased susceptibility to corn leafhoppers. The high-yielding, early maturing hybrids that have been widely commercialized in temperate regions appear to be generally more attractive to corn leafhoppers compared to tropical corn hybrids. Although varieties have been categorized for resistance to corn stunt, and cultivars expressing Bt traits vary in susceptibility, the genetic foundations of corn stunt resistance traits have not yet been systematically examined.

Management

Most research on the management of corn leafhopper and its disease complex has been conducted in tropical and subtropical regions, and therefore, may not be readily applicable to Kansas corn production. The regionally synchronous planting of short-season cultivars to ensure corn-free periods annually, combined with a program to control volunteer plants, is the foundation of corn leafhopper management in Central and South America, along with control of grassy weeds around field borders. Corn-free periods can break the "green bridge" effect, driving corn leafhopper populations to low levels by depriving them of host plants. However, adults are strongly dispersive, and those that do not find host plants will opt for migration.

In Kansas, corn leafhopper infestations will be caused by seasonal migrants from lower latitudes, so later plantings will be more at risk than earlier ones, even though corn in early stages is more attractive to corn leafhoppers. Post-harvest removal of volunteer corn is also a conventional

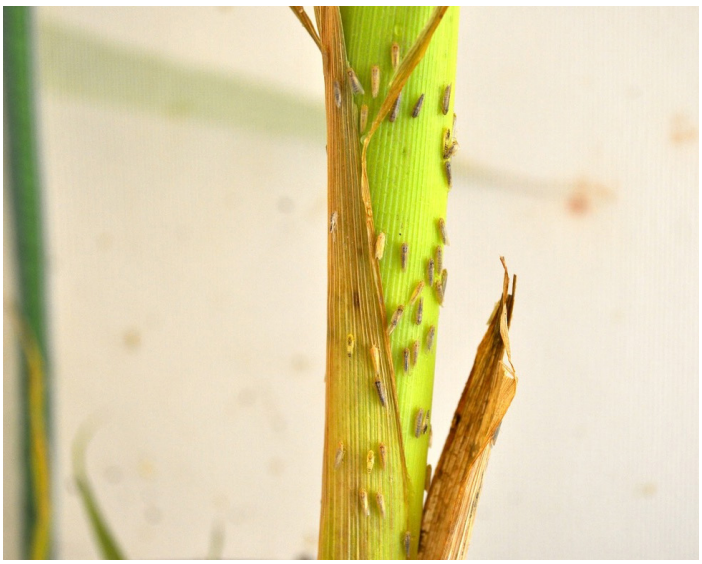

Figure 2. Immature nymphs vary from translucent yellow to dark brown.

Figure 3. Adult corn leafhopper.

management tactic for reducing corn leafhopper survival between early and late plantings; however, it is unlikely to be useful in Kansas, where corn is planted only in spring.

Although most commercial seed is now treated with a neonicotinoid insecticide, which provides about two weeks of protection for young plants, most Kansas corn is unlikely to be colonized by corn leafhoppers until much later stages of development, when seed treatments have worn off. Some farmers have sought to compensate for stunting by increasing nitrogen fertilization, but this practice is counterproductive because excessive nitrogen also increases plant attractiveness and suitability for corn leafhoppers.

Modern corn cultivars can vary in traits conferring some resistance to corn leafhoppers; midrib hardness is one trait that impedes the feeding efficiency of developing nymphs. However, relentless breeding for increased corn yields is thought to have compromised a variety of plant anti-herbivore defenses that took many thousands of years to evolve naturally in the ancestral plant, including the production of volatiles induced by corn leafhopper feeding that serve to both deter additional colonists and attract natural enemies.

Yellow sticky traps are a quick and low-cost means of determining the presence and estimating the density of corn leafhopper infestations. Studies in Brazil suggest that one trap every 8 acres, checked and replaced weekly, is sufficient for a binomial (presence/absence) sampling protocol. There is no established economic threshold; in subtropical regions, the mere presence of the insect is often considered justification for an insecticide application. It is not yet clear whether any monitoring (or spraying) for corn leafhopper will be justified in Kansas, as disease dynamics will differ from those observed in subtropical regions, and most corn will not be infested until later stages of development.

The effect of the disease, and hence, the justification for any corn leafhopper control measures, will depend on the number of corn leafhoppers arriving, the timing of their arrival relative to crop development, the proportion of corn leafhoppers infected with spiroplasma, and the relative susceptibility of the cultivar, among other factors. Losses to disease will be greater when corn leafhopper is detected in earlier stages of the crop, and thin stands appear more attractive to hoppers due to increased contrast between plants and bare ground.

Biological Control

In subtropical regions, formulations of various entomopathogenic fungi have been developed that can be applied alone or in combination with synthetic insecticides for corn leafhopper management. Some entomopathogenic fungi interfere with corn leafhopper feeding behaviors such as plant probing, which can help reduce disease transmission in addition to causing mortality. However, entomopathogenic fungi typically require high-humidity conditions to induce epizootics in the field, which are not characteristic of the corn-growing season in Kansas.

Most research on biocontrol of corn leafhoppers has focused on parasitoids, especially wasps in the family

Figure 4. Plant at early growth stage. Photo Credit: Clemson University - USDA Cooperative Extension Slide Series, Bugwood.org

Figure 5. Symptoms of an infestation.

Mymaridae (fairyfly wasps), a family that commonly attacks the eggs of leafhoppers and planthoppers, and several wasp species in the family Trichogrammatidae. The minute fairyfly wasp (≈ 0.7 mm total body length), *Anagrus virlai*, is the primary egg parasitoid of the corn leafhopper in the Americas.

Oviposition by corn leafhopper in corn plants has been shown to elicit the release of volatile organic compounds, which are specifically attractive to egg parasitoids such as *A. virlai*, although the response of modern hybrids is much lower than that of wild relatives. Despite the attention paid to parasitoids, generalist predators such as lady beetles, lacewings, earwigs, predatory bugs, spiders, and many other species are known to prey on corn leafhopper, especially immatures, and likely contribute to population suppression. Corn leafhoppers are not tended or protected by ants, as are other phloem-feeding insects that secrete honeydew. Evidence suggests that many ant species prey upon immature stages and can reduce populations locally.

The presence of natural enemies can also diminish disease transmission by changing the rate of leafhopper development and altering behavior. Although biological control alone cannot be relied on to reduce populations of disease vectors such as corn leafhoppers to levels that provide economically acceptable disease control, biological control agents are still worthy of conservation in any integrated management plan.

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