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Corn Leafhopper and the Red Stunt Disease Complex

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Background. The corn leafhopper, *Dalbulus maidis*, is thought to have originated in Mexico and is a semitropical/tropical pest of corn. It was originally described in Puerto Rico in 1923. Since 2015, it has become one of the most destructive corn pests in Brazil, and more recently in Paraguay and Argentina, primarily because of the diseases it vectors. In the United States, corn leafhoppers are an occasional pest, but are most common in southern Texas, the southern San Joaquin Valley of California, and Florida. Corn leafhoppers and their associated diseases were commonly reported from 1945 to 1980. In 1981, it was reported as far north as Ohio. It reemerged as a pest in South Texas in 2016. In 2024, outbreaks were reported in northern Tamaulipas, Mexico and it subsequently became widely distributed throughout Texas; Oklahoma; eastern New Mexico; and portions of Kansas, Missouri, and Arkansas. In 2024, corn leafhoppers were also detected late season in Illinois, Indiana, Nebraska, Minnesota, and Wisconsin.

Description. The adult insect is about 1/8 inch in length, light tan, and torpedo-shaped. It can be distinguished from other leafhoppers common in corn by the two dark spots located between its eyes (Figure 1). The nymphs appear similar to the adults, but lack wings and may be green or tan in color. The adults are highly active and rapidly run away or will jump and fly when disturbed. Corn leafhopper adults feed within the corn whorl, but will move onto the underside of the leaves as the corn grows (Figure 2). Nymphs are generally most prevalent on the underside of the leaves.

Figure 1. Corn leafhopper adults are identified by the presence of two black spots located between their eyes. *(Photo courtesy of Danielle Sekula, Texas A&M AgriLife Extension)*

Figure 2. Corn leafhopper adults and black sooty mold. *(Photo courtesy of Danielle Sekula, Texas A&M AgriLife Extension)*

Host Range. Corn, and its close relative teosinte, are considered the primary hosts of corn leafhoppers, although eastern gamma grass, *Tripsacum dactyloides*, may also serve as a host. Eastern gamma grass is a very common grass species throughout Texas. Corn is considered the best host, whereas development is slower on eastern gamma grass. In a greenhouse study, corn leafhoppers were able to complete five generations on eastern gamma grass, but the identification of populations reproducing on eastern gamma grass in the field has not been reported. The role, if any, that eastern gamma grass plays in corn leafhopper outbreaks is unknown. Whether or not corn leafhoppers are capable of reproducing on other *Tripsacum* species is also unknown. Adults of corn leafhoppers are able to feed and survive on many grass species, including sorghum, Johnsongrass, signalgrass, and millet. They may survive on these hosts for over 1 month, but they do not reproduce on these plants.

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Lifecycle. Corn leafhoppers require 1,167 degree days above a threshold of 41 degrees Fahrenheit to complete a lifecycle. They lay eggs when the temperature ranges from 59 to 104 degrees Fahrenheit. Corn leafhoppers have been shown to suffer 50 percent mortality when exposed to 23 degrees Fahrenheit for 3 to 3.5 hours. Adult female corn leafhoppers will lay around 130 to 611 eggs per female by inserting eggs individually, mainly into the upper side of the leaf along the base of the midvein. A single female may lay approximately 15 eggs per day. Eggs will incubate for about 8 to 11 days before hatching. The nymphs will pass through five nymphal instars requiring 13 to 17 days (Figure 3). Egg to adult development requires 21 to 28 days, but this is highly dependent upon temperatures. Reported adult longevity varies greatly, ranging from 16 to 88 days, although longer survivals have been noted.

Figure 3. Corn leafhopper nymphs and black sooty mold. *(Photo courtesy of Danielle Sekula, Texas A&M AgriLife Extension)*

Corn leafhoppers do not truly overwinter because they need a living host year-round. The range of the corn leafhopper is primarily constrained by the availability of suitable host plants rather than by temperatures. Corn leafhopper adults can survive at temperatures of 50 to 68 degrees Fahrenheit in the absence of corn by sporadically feeding on other grass species. Therefore, areas that experience freezing temperatures will not support corn leafhopper populations for infestation of first cropped corn during the early season. Insects also have to migrate north as they develop during the spring and summer. Individual corn leafhoppers can disperse locally up to 12.5 miles, but their long-distance dispersal capabilities are not known. However, they have been thought to move up to 60 miles. Hence, corn leafhoppers are more often problematic in the U.S. in subtropical regions such as southern areas of Texas, Florida, and California.

Corn Leafhopper Damage. Corn leafhoppers have piercing-sucking mouthparts and are primarily phloem-feeding insects, although they will ingest some xylem fluids. Feeding is thought to cause the greatest damage, although the egg-laying behavior of females may also cause significant damage. In addition to feeding and egg-laying damage, the copious amounts of honeydew produced by corn leafhoppers will result in the growth of black sooty mold fungi, which will cover leaf surfaces (Figure 4). The sooty mold will block sunlight from leaves, resulting in reduced photosynthesis which may also result in yield loss.

Figure 4. Honeydew produced by corn leafhoppers is a sugary substance that will grow saprophytic fungi termed "sooty mold," which may block leaf photosynthesis. *(Photo courtesy of Danielle Sekula, Texas A&M AgriLife Extension)*

Damage by the insects themselves can cause economic injury to corn, but risk occurs primarily in second cropped corn in the United States. The younger the corn, the more sensitive it is to corn leafhopper feeding damage. Additionally, drought-stressed corn is more sensitive than well-watered corn. It has been demonstrated that drought-stressed, 10-day old corn exposed to 10 corn leafhoppers for 7 days suffered 12.5 percent plant mortality, 65 percent reduction in leaf mass, and 18percent reduction in root mass. Well-watered corn suffered no plant mortality, 39 percent reduction in leaf mass, and 26 percent reduction in root mass. In another study, silage corn at vegetative stage V6 averaging 180 corn leafhopper nymphs per leaf suffered about 44 percent reduction in yield. Silage corn at V9 averaging 25 nymphs per leaf did not suffer any yield loss.

Vectored Diseases. The biggest risk of damage to corn from corn leafhoppers is from the plant pathogens it transmits. Corn leafhoppers are known to transmit four corn pathogens; two are bacterial and two are viral. The bacterial pathogens are corn stunt spiroplasma (CSS; *Spiroplasma kunkelii*), and maize bushy stunt phytoplasma (MBSP; *Candidatus* Phytoplasma asteris subgroup 16SrI-B). The viral pathogens are the maize rayado fino virus (MRFV; family Tymoviridae; genus *Marafivirus*) and maize striate mosaic virus (MSMV; family Geminiviridae; genus *Mastrevirus*). Together, these four pathogens form an aggressive disease complex known as "*achaparramiento*" or red stunt (Figure 5).

In any single feeding event, infected corn leafhoppers may transmit any or all these pathogens after acquiring them from an infected host. When a noninfected corn leafhopper feeds on an infected plant, most of the pathogens must multiply within the insect for a period before the insect is capable of transmitting the

pathogen. The period is 3 to 4 weeks for CSS and MBSP, and 2 weeks for MRFV. Conversely, MSMV is persistent but non-propagative in corn leafhopper. First instar corn leafhoppers can transmit MSMV more efficiently than the adults. For all the pathogens, an infected corn leafhopper remains infected for the duration of its life. However, its ability to transmit the pathogens declines as the leafhopper ages.

Both CSS and MBSP were detected in Texas corn in 2024. At the time of writing this bulletin, we do not yet know if MRFV or MSMV were present, although MRFV was detected in corn in south Texas and south Florida in the 1980s. Maize striate mosaic virus was detected in Brazil in 2022, but has not been detected in the U.S. Corn and teosinte are the only hosts known to serve as red stunt disease reservoirs, but information on host reservoirs is incomplete. Efforts to infect eastern gamma grass using CSS-infected corn leafhoppers have been unsuccessful.

Symptomology Attributed to Red Stunt Disease in Texas in 2024

Note: Corn can be infected with the pathogens vectored by corn leafhoppers and remain asymptomatic. Symptomatic plants tend to become evident initially along the field borders. Crop age at time of infection undoubtably affects symptomology and yield loss potential. Pathogen transmission during VE to V8 is the most critical period resulting in economic crop damage.

- Yellowing and reddening of leaves (Figure 5: middle and left)
- Rapid lower canopy desiccation (Figure 6)
- Ear leaf and corn husk desiccation (Figure 7: right)
- Occasional dead or severely affected plants (Figure 8: left and right)
- Poor pollination (Figure 9: left) and extensive blank ear tips (Figure 9: right)
- Incomplete kernel fill (Figure 10: top left and right, and bottom left and right)
- Stunted plants (Figure 11: left) or plants that are excessively thin and tall, often with multiple ears per plant (Figure 11: right)
- Thin, barren plants (Figure 12: left) or formation of multiple deformed ears from the primary ear position (Figure 12: middle)
- Abnormal tillering (Figure 12: right)

Figure 5. Corn leafhopper adult on a symptomatic leaf (left), a plant with extensive yellowing and reddening (middle), and leaves with extensive red stunt symptomology (right). *(Photos courtesy of: Bracken Finney, Wilbur-Ellis (left and middle); Steve Carlson, Bayer CropScience (right))*

Figure 6. Water-deficit corn suffering red stunt disease and acclerated lower plant desiccation. *(Photo courtesy of Danielle Sekula, Texas A&M AgriLife Extension)*

Figure 7. Red stunt disease in the ear leaf (left) may result in splitting of the leaf collar around the ear shank (middle) and dessication of the ear husk (right). *(Photos courtesy of: Bracken Finney, Wilbur-Ellis (left and middle); Steve Carlson, Bayer CropScience (right))*

Figure 8. An occasional plant showing extensive red stunt disease symptomology.
(Photos courtesy of Stephen Biles, Texas A&M AgriLife Extension)

Figure 9. Red stunt disease may result in malformed tassels and/or pollen formation, or sterility, causing poor pollination.
(Photos courtesy of: David Kerns, Texas A&M AgriLife Extension (left); Danielle Sekula, Texas A&M AgriLife Extension (right))

Figure 11. Late-planted corn tends to suffer more severe injury from red stunt disease. The later the planting, the greater the risk. Affected plants may be stunted (left) or taller than surrounding unaffected plants, and may be barren or produce multiple small ears per plant (right).
(Photos courtesy of: Scott Keeter, FertiTex (left); Steve Carlson, Bayer CropScience (right))

Figure 10. Red stunt disease during kernel fill may result in small, incompletely filled (shriveled) kernels and smaller ears (top left and right). Affected ears have been shown to result in a 66 percent reduction in yield (bottom left and right). *(Photos courtesy of: Stephen Biles, Texas A&M AgriLife Extension (top left); Bracken Finney, Wilbur-Ellis (top right); David Kerns, Texas A&M AgriLife Extension (bottom left and right))*

Figure 12. Affected corn plants may be barren (left), produce multiple ears at the primary ear position (middle), and may exhibit uncharacteristic tillering (right). *(Photos courtesy of: David Kerns, Texas A&M AgriLife Extension (left); Beck Johnson, Johnson Agronomics (middle); Scott Keeter, FertiTex (right))*

Corn Stunt Spiroplasma (CSS). Corn stunt spiroplasma symptoms first appear about 3 to 4 weeks after inoculation. The symptoms begin as broad, yellow streaks at the base of newly infected leaves and leaves that develop post-inoculation. Older leaves may turn red or golden-yellow. Infected plants at the reproductive stage may have the characteristic yellowing confined to the base of older leaves and/or the ear leaf. Plants may be stunted; may have malformed tassels; and have ears that are small, deformed, or missing. Symptoms of plants infected early in the season are usually more severe than those infected later in the season.

Maize Bushy Stunt Phytoplasma (MSBP). Maize bushy stunt phytoplasma symptoms first appear 2 to 3 weeks after inoculation. Infected plants exhibit more severe yellowing and reddening than CSS. Plants are often stunted and produce many tillers and axillary shoots, giving it a bushy appearance. Infected reproductive plants may not produce a tassel, and the symptoms are difficult to distinguish from CSS.

Maize Rayado Fino Virus (MRFV). Maize rayado fino virus symptoms occur 7 to 10 days after infection. Unlike CSS and MBSP, MRFV does not cause extensive leaf reddening, but yellowing occurs if large areas of the leaf are affected. The symptoms first appear as rows of small chlorotic spots on leaves, which coalesce into chlorotic strips along the veins. Stunting may occur, although plants infected after tasseling may not show symptoms.

Maize Striate Mosaic Virus (MSMV). Initial symptoms of MSMV occur 8 to 11 days after inoculation. The initial symptoms are visible on youngest leaves as small, light spots on the lower exposed part. As the disease progresses, newer leaves emerge which have mild chlorotic streaks along the leaf veins, and there is a reduction in the size of the corn plant.

Other Vectors of these Pathogens. In addition to the corn leafhopper, the black-faced leafhopper, *Graminella nigrifrons*, and the Mexican corn leafhopper, *Dalbulus elimatus*, have been implicated in transmitting CSS, MBSP, and MRFV. Most recently, the African planthopper, *Leptodelphax maculigera*, was reported to harbor MBSP, MRFV, and MSMV in Brazil in 2024. These leafhoppers have not been as extensively studied as the corn leafhopper. Neither the Mexican corn leafhopper or the African planthopper are known to occur in the United States. The black-faced leafhopper is widely distributed throughout Texas and the eastern U.S., can live and reproduce on a wide variety of grass species, and can overwinter as an adult or an egg. Outbreaks of CSS in Mississippi in the 1960s were in large part attributed to black-faced leafhoppers. However, there is insufficient field evidence to indicate that black-faced leafhopper is an effective vector of CSS, MSBP, or MRFV.

Experiences with Corn Leafhopper and Red Stunt in Texas in 2024. Much of the information we have is anecdotal in nature. Early planted corn did not seem to be affected as much by red stunt as later plantings. They also did not seem to have widespread disease symptomology. Regardless of when the disease symptoms became evident, we know that the symptoms require 3 to 4 weeks to begin to show. Most corn was probably infected with red stunt around V6 to V8 or earlier. Based on simple observations, it appears that some corn hybrids differ in their susceptibility to red stunt disease or the leafhoppers. Yield loss attributed to red stunt disease during 2024 has been highly variable, but the most severe may have been as high as 40 bushels per acre, or a 25 percent yield reduction.

Additionally, red leaf symptoms attributable to broken midribs were also observed in some fields. In diagnosing a problem in the field, other, nonpathogenic causes of reddening, such as ear rot or lack of pollination, should be evaluated. Nonpathogenic factors such as low fertility, high plant populations, poor timing of silking, and poor pollen shed can contribute to barren stalks and ears without grain.

Lower Rio Grande Valley. Corn leafhoppers began to become evident in corn in the Texas Lower Rio Grande Valley in early May, with high populations and sooty mold common in fields of irrigated corn. At that time, most corn was already at the dough (R4) reproductive stage and red stunt disease was not widely evident. Populations of corn leafhoppers continued to increase throughout the month of May.

By the third week of May, later-planted corn at the same R4 stage had a high incidence of red stunt symptoms including desiccated bottom leaves due to extensive accumulation of honeydew with sooty mold, and poor ear development. By mid-June, corn leafhopper populations drastically declined as corn dried down for harvest.

Coastal Bend. By late May, corn leafhoppers were common in Victoria County averaging 1 to 30 leafhoppers per leaf, and most corn was at early dent (R4 to R5). Some fields exhibited symptoms of red stunt and experienced less than two percent plant mortality. Overall, the insect and disease did not seem to negatively impact grain yields in the Victoria area. Growing conditions were good for corn production, with fields averaging 110 to 150 bushels per acre, which is 20 to 50 percent above the 10-year average yields. A corn field treated with Sivanto® Prime at 7 fluid ounces per acre by ground using 10 gallons per acre spray volume provided 80 percent leafhopper control 3 days after treatment. Sivanto® Prime can be a little slow-acting, so control likely improved 7 days after treatment.

Central Texas. In early June, corn leafhoppers and red stunt were common in the Texas Southern Blacklands and the Brazos River Bottom. Similar to observations in Victoria County, a small number of plants died. Living, infected plants appeared to grow fine until R3, when kernel development appeared to cease. Because of frequent rain events, much of Central Texas corn planting was more chronologically spread out than normal. In the Southern Blacklands, corn planted in mid-March or later appeared to be most impacted by red stunt disease. Corn planted in mid-April in Burleson County exhibited approximately 10 percent of ears that ceased grain fill at R3. These ears yielded 66 percent less grain weight than non-affected ears. Other mid-March planted corn suffered severe pollination issues. Corn planted for experimental purposes in mid-May was essentially wiped out. Reddening was common, some plants died, and many plants produced no ears.

Northern Texas Blacklands. In the Northern Texas Blacklands, corn planting dates were spread out from late February through mid-April due to frequent rains. Corn leafhopper populations in Hill and McLennan Counties were first noticed in the middle of June and symptoms of red stunt were observed by the first of July. In the more northern counties of Bowie, Delta, Fannin, Hunt, Lamar, and Red River, corn leafhoppers were first noted in late June, with scattered corn disease symptoms manifesting in July. When red stunt first appeared, earlier planted fields were past pollination and progressing into later reproductive stages of development. Corn planted after the middle of March was hit hardest by corn leafhopper feeding and associated pathogens, with some plants succumbing to the disease. Most plants continued to grow normally around the R3 growth stage before grain fill stopped. Significant yield losses were noticed across the region, but it is difficult to estimate the proportion of yield losses caused by red stunt. This is due to confounding yield-reducing factors of excessive moisture early in the season, followed by hot and dry conditions during and after pollination. Field observation of hybrid trials suggest that corn hybrids vary in their response to corn leafhoppers and their various vectored pathogens.

Texas Panhandle. In late August, corn leafhoppers and red stunt disease were evident in Castro, Deaf Smith, Moore, and undoubtedly additional counties. Plants that were apparently healthy showed shrunken, wrinkled kernels or complete ears that did not develop. Other plants showed the purplish-reddish coloration associated with corn stunt disease. In Deaf Smith County, a producer of fully irrigated yellow and white corn reported the incidence of affected plants in his field to range from one to 10 percent. The number of corn leafhoppers in a field in Moore County averaged 0.55 per plant in some areas. Honeydew and sooty mold were also evident in some fields in Castro County.

West Texas. Around mid-June, corn leafhoppers were observed in several irrigated fields across Tom Green County. Despite their presence, no visible damage was detected during scouting events. This is most likely due to the timing of the initial infestation and because corn was between stages R2 and R6 of development. Also, extreme weather conditions across West Texas during the 2024 season, including heat, drought, and hail, made it challenging to assess red stunt disease in most corn acres in late June. In a partially irrigated corn field in Tom Green County, an average of 1.8 leafhoppers per plant were found on June 20th, but there were no visible signs of red stunt disease. Results from an ad hoc foliar test in the same field showed that the pyrethroids lambda-cyhalothrin at 5.12 fluid ounces per acre and bifenthrin at 6.4 fluid ounces per acre effectively controlled leafhoppers at a rate greater than or equal to 90 percent. Dimethoate at 1 pint per acre provided decent control ranging from 70 to 80 percent over 14 days. Glistening honeydew was present at low levels as leafhoppers were discovered soon after their arrival. Yield differences were not assessed due to poor cob development caused by high heat, hail, lodging by wind, and the lack of rainfall and irrigation.

Leafhopper and Red Stunt Disease Management. Because of our limited recent experience with this insect/disease complex, much of the information presented here is from Brazil and Argentina where there are corn hybrids with some partial resistance to corn leafhoppers. However, red stunt disease is still a major issue, especially in their late-planted corn. Additionally, they commonly have high populations of corn leafhoppers and treat them aggressively with insecticides from growth stages V2 through V8. They also have severe issues with corn leafhoppers being resistant to many insecticides, including pyrethroids such as bifenthrin, lambda-cyhalothrin, and others; and neonicotinoids such as clothianidin, imidacloprid, and thiamethoxam. Currently, they manage corn leafhoppers primarily with methomyl (Lannate) and acephate. Neither of these are labeled for use on corn in the U.S. Also, two entomopathogenic fungi, *Beauveria bassiana* and *Cordyceps fumosorosea*, are strongly recommended in mixtures with chemical insecticides. These biological products are not recommended individually since their efficacy is less than 35 percent, but are used in combination with chemical insecticides. Eliminating volunteer corn has been the main focus in South America for reducing corn leafhopper populations and the disease pathogens they vector.

For U.S. corn growers, we suggest the following.

1. **Plant resistant corn hybrids.** Currently, we do not have this option because we do not know which commercial hybrids in the U.S. offer resistance. If the corn leafhopper problems persist, there will be a need to screen corn hybrids for corn leafhopper and red stunt resistance.

2. **Volunteer corn management.** In areas that may not experience killing freezes, it is essential to eliminate volunteer corn. Volunteer corn serves as a green bridge host for the corn leafhopper and as a reservoir for the causal agents of disease.

3. **Plant as early as possible.** Early-planted corn is not affected as much by corn leafhoppers and its diseases. It is simply a matter of getting the corn beyond V8 before the leafhoppers infest it.

4. **Use a high seed treatment rate of insecticide.** This is especially important for late-planted or second crop corn. Seed treatments containing Cruiser® Corn 1250 or Poncho® 1250 should provide protection from corn leafhoppers until V3 through V8. In Brazil and Argentina, corn leafhoppers have resistance to these insecticides. Resistance in the U.S. is unknown, but is unlikely.

5. **Scouting and treating for corn leafhoppers.**

   When. Data from Brazil and Argentina suggests that corn VE to V5 is the most critical window to prevent yield-damaging pathogen infections. However, protecting through V8 is recommended. To effectively manage corn leafhoppers and lessen the risk of red stunt transmission, the corn should be scouted from V3 through V8. If you are not using Poncho® 1250 or Cruiser® 1250 seed treatments, then begin scouting at V1 to V2.

   How. In prereproductive corn, corn leafhoppers are usually congregated on the whorl leaves. As the insect population increases in reproductive corn, they may be found throughout the corn plant, primarily on the underside of the leaves. Honeydew and sooty mold are good indicators for leafhopper presence. Corn leafhoppers tend to aggregate and are most numerous along the field margins.

   Visual scouting will not be very effective because detection of corn leafhoppers is needed before they become numerous. The best method is to utilize a battery-powered leaf vacuum with a pantyhose stocking positioned over the funnel. Then, simply vacuum-sample the plants and see if you are capturing any corn leafhoppers. Alternatively, you could use a sweep net, but sweeping plants smaller than V5 may be difficult.

   Treatment. With the detection of any corn leafhoppers, you should assume they are potentially viruliferous. In turn, this should trigger an insecticide application. The currently labelled insecticides that may control corn leafhoppers include Sivanto® Prime and Transform®, and products with the active ingredients chlorpyrifos, dimethoate, and pyrethroids such as bifenthrin. The efficacy of these products, their residual control, and ability to prevent red stunt disease transmission in the U.S. are not fully known. In 2024 efficacy trials, the pyrethroids bifenthrin and lambda-cyhalothrin provided excellent control for at least 7 days, and dimethoate provided good control. Anecdotal evaluation of a Sivanto® Prime application suggests that it has very good activity as well. Corn growers should use caution if utilizing pyrethroids, and to a lesser extent, dimethoate or chlorpyrifos, to manage corn leafhoppers because these products may flare spider mite populations.