

Corn Stunting Virus Diseases in Missouri

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First reports of stunting virus diseases of corn were made in Missouri in 1963 from three southeastern counties. Similar reports were made from neighboring states. Virus or virus-like diseases of corn have been reported annually since the time of the first appearance in epidemic proportions in the southern part of the Corn Belt. Infections occur in more than 7,000 acres annually in Missouri.

Since 1963, losses ranging from 5 to 95 per cent in individual fields have been reported in Missouri. The most severe losses have occurred in bottom land fields along the Gasconade and Missouri rivers.

Most of these areas have fields that are surrounded or infested by Johnsongrass, a common perennial weed grass proven to be a principal over-wintering host for two corn viruses, maize dwarf mosaic virus and maize chlorotic dwarf virus.

Cause

When a corn stunting disease first appeared in the Corn Belt in the early 1960's, it was believed that the so-called "corn stunt" disease identified in several Southern and Southwestern states had somehow been transferred to the Midwestern states.

Investigations in 1963 by plant pathologists at the Ohio Agricultural Experiment Station proved that healthy susceptible corn seedlings could be infected by introducing filtered juice from diseased corn or Johnsongrass plants through very small wounds in the leaves. This method of inoculation established rather conclusively that the disease was caused by a virus. Further research in Missouri and several other states confirmed this finding.

The fact that this virus disease was transmitted mechanically distinguished the new disease from corn stunt, a mycoplasma-caused disease which had similar symptoms but could not be transmitted by sap inoculation. The virus identified in 1963 was named "maize dwarf mosaic virus" (MDMV). The name was descriptive of the symptoms—mosaic and dwarfing.

In the late 1960's, virologists conducted in-depth examinations of the so-called "yellows diseases." The causal agents are generally leafhopper transmitted and are not sap transmissible. With electron microscopy and ultrastructure studies, it was shown that the corn stunt disease was caused by a mycoplasma-like organism rather than a virus.

In the early 1970's, the Ohio virus group identified another virus, the "maize chlorotic dwarf virus" (MCDV), in several Corn Belt and Southern states. MCDV has been established as a prevalent corn virus disease in Missouri—probably more common than the maize dwarf mosaic virus.



Since 1963, corn virus disease has caused serious losses in corn fields in Missouri.

Circumstantial evidence suggested the presence of the corn stunt disease in Missouri for some years following the early 1960's. Stunted corn plants were observed but proved negative in sap transmission assays. With the discovery of the MCDV, which is also non-sap-transmissible, it is improbable that the mycoplasma-caused corn stunt has been involved in Missouri. Additional studies in this direction are needed.

Wheat streak mosaic virus (WSMV) has been identified in Missouri. The disease is usually found where corn fields are adjacent to wheat fields.

Identification

Maize Dwarf Mosaic Virus. Symptoms of MDMV vary considerably, even in corn plants of the same hybrid in the same field. One plant may show symptoms early in the season, while another not until after pollination. Diseased plants are often found in spots or centers within a field. Frequently, such infection centers may appear along one side or at the end of a field, suggesting a correlation with the movement of insect carriers (vectors) of the virus.

First symptoms of MDMV appear in younger leaves as indistinct light and dark green mottling between the veins, or as elongated pale green blotches and interrupted stripes. The blotches and stripes often merge, and the leaves become quite yellow, giving plants a pronounced yellowish cast. Corn plants showing this mosaic pattern are often dwarfed or stunted due to a shortening of the upper internodes. This gives young plants a bushy or "feather duster" appearance. Some plants show only moderate stunting.

Reduced ear size, barrenness and poor seed set may be involved in very susceptible strains of corn. Diseased plants may have none to several ear shoots. In general, ears remain poorly filled on plants infected early in the season.



The first symptoms of maize dwarf mosaic appear in the younger leaves as light and dark green mottling between the veins.

MDMV can be transmitted mechanically by sap from infected plants, using susceptible corn seedlings as assay plants. Under the electron microscope, MDMV is characterized as flexuous, rod-shaped particles.

There are two principal strains of MDMV—one associated with Johnsongrass, the other a so-called “non-Johnsongrass strain.” Both are present in Missouri. MDMV resembles the sugar cane mosaic virus in symptoms, general host range, and mode of transmission. It is believed that it is a strain of the sugar cane mosaic virus.

How MDMV is spread in the field from infected Johnsongrass to corn plants is not understood fully. It has been proven that the corn leaf aphid, *Rhopalosiphum maidis*, as well as several other common aphid species, are the main carriers (vectors) of the virus.

Maize Chlorotic Dwarf Virus. Rather than the typical mosaic patterns in the infected leaf tissues caused by MDMV, the MCDV causes vein clearing. When the leaves are held to the light, vein clearing is observed easily in the tertiary veins near the base of the leaf.

Plant symptoms include stunting, shortened internodes and yellowing of the leaves. Reddening of the leaves may be present in certain corn strains. There are considerable variations in host symptom responses, just as with MDMV. Coincidentally, Johnsongrass is the principal perennial alternate host of both MCDV and MDMV.

By contrast, MCDV cannot be transmitted by sap inoculation to assay plants but can be transmitted by a certain type of insect. The leafhopper, *Graminella nigrifrons*, is presumed to be the major vector. Using electron microscopy, MCDV has been characterized as having spherical (polyhedron) particles.

Wheat Streak Mosaic Virus. Early symptoms of wheat streak mosaic virus (WSMV) appear as small chlorotic spots or broken streaks at the tips of young leaves. Streaks elongate and develop parallel to the veins. Older leaves may become chlorotic near the tips with green margins bordering the veins. General yellowing and stunting of plants may occur, as in MCDV or MDMV. Ears may be developed poorly and have poor seed set.

Transmission of WSMV is by the wheat curl mite, *Eriophyes (Aceria) tulipae*. Infected mites migrate from wheat fields adjacent to corn.

Corn Stunt. The corn stunt disease (caused by a mycoplasma-like organism) is transmitted in nature only by certain leafhopper species. Two leafhopper species, *Dalbulus maidis* and *D. eliminatus*, are the principal vectors. These leafhoppers are not native to Missouri, and the occurrence of the disease in Missouri is unlikely.



Virus-infected corn plants are usually stunted due to shortening of upper internodes.

Controls

Development of resistant or tolerant corn hybrids offers the best long-lasting method of control. The University of Missouri has had an ongoing program of evaluation of inbred lines and hybrids under conditions favorable for intense natural infection. Research plots have been placed in Jefferson County near House Springs and at the Delta Experiment Station near Portageville, where Johnsongrass has been prevalent. These two areas have a high inoculum potential.

From inbred lines that have shown high tolerance to both MDMV and MCDV, commercial hybrids have become available for use in areas of Johnsongrass infestations where corn virus infections are a hazard.

Further information on tolerance ratings for corn strains grown in Missouri is contained in the ARS North Central-39 publication, “Virus Tolerance Ratings for Corn Strains Grown in the Lower Corn Belt.” This publication provides data on the performance of commercial hybrids as well as inbred lines.

Johnsongrass has been a problem weed for many years in most of the virus-infected areas where corn is grown extensively. Generally, where heavy infestations of Johnsongrass have been found, the virus disease problems have been very severe. Therefore, the eradication of Johnsongrass in corn and sorghum, and perhaps in other crops, is highly desirable. Information on Johnsongrass control is contained in UMC Guide 4860, “Johnsongrass Control in Row Crops.”

Controlling virus diseases with insecticides which kill the virus-carrying insect vectors has not been successful. Most commonly used insecticides will not kill the insects quickly enough to prevent initiation of feeding and the subsequent inoculation of the virus into the plants. Timing of insecticide applications also presents a very great problem. Certain systemic insecticides in Missouri have shown some degree of promise, but probably only as repellents.



Johnsongrass is a principal perennial over-wintering host for both MDMV and MCDV.