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report on
PLANT DISEASE

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WHEAT STREAK MOSAIC

Wheat streak mosaic, caused by the wheat streak mosaic virus (WSMV), is a serious and widely distributed disease of winter wheat. Wheat streak mosaic also occurs on spring wheat and barley, corn, rye, oats, and a number of annual and perennial grasses (Table 1). It was first recognized in Nebraska as "yellow mosaic" in 1922. Since then, although sporadic in its appearance and severity, wheat streak mosaic has caused losses throughout central and western North America, eastern Europe, parts of Russia, and North Africa. Wheat streak mosaic is most prevalent and damaging in the central Great Plains area of the United States. The first serious outbreak of the disease occurred in Kansas in1949, when the loss was estimated at $30 million. In 1959, the loss from wheat streak mosaic in the same state amounted to $80 million.

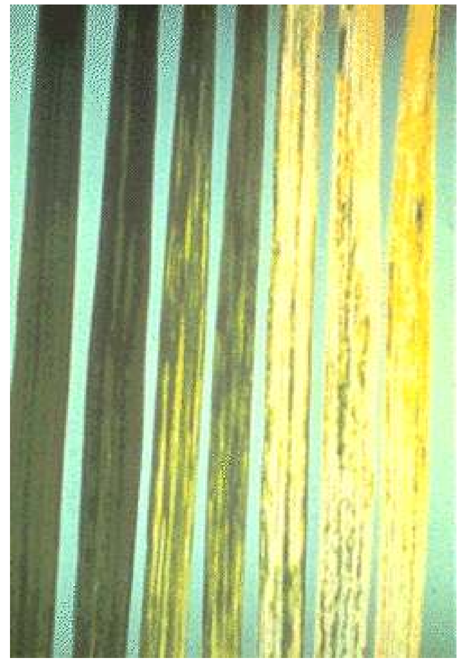

Figure 1. Left, healthy wheat leaf; chlorotic leaf streaks parallel to the veins caused by virus infection.

Damage to winter wheat is most severe in fields planted next to volunteer wheat or cereal stubble that was not plowed down before sowing. Yield losses in wheat can be as high as 100 percent, depending on the time of infection and other factors. The greatest loss occurs in fall-infected fields that were seeded early. Plants that become infected in the early spring develop leaf symptoms, and yield losses range from 0 to 30 percent. Infections that occur in the late spring usually cause little or no loss in yield or in grain quality although losses up to 98 percent have been reported.

Wheat streak mosaic was first found in Illinois in 1966, near Brownstown. During 1967, it was positively confirmed from wheat collected in the following counties: Bond, Clinton, Fayette, Franklin, Hamilton, Jackson, Jasper, Monroe, Piatt, Richland, St. Clair, and Washington. The disease was probably present in other counties, but was not detected.

In May of 1967, an extensive survey of wheat fields through the southern half of Illinois revealed wheat streak mosaic in every field of volunteer wheat surveyed as well as in wheat fields adjacent to or near volunteer wheat. These observations were supported by positive recoveries of the WSMV and by positive transmission with the mite vector in greenhouse tests.

During 1976 and 1977 outbreaks of the disease in Illinois, serious economic losses occurred on wheat, sweet corn, and dent corn in Madison, Monroe, and St. Clair counties. Field surveys showed that the WSMV was generally distributed south of Springfield and west of interstate 57. Scattered damage to wheat and dent corn was observed in Fayette, Jackson, Macoupin, Perry, Randolph, Sangamon, and Washington counties.

Damage to wheat was closely associated with double-cropping and the presence of volunteer wheat. Damage to sweet and dent corn was associated with wheat fields infected with the WSMV. Most severe losses occurred where corn was infected early in its growth. A lack of pollination and small ears were common on corn plants infected by wheat streak mosaic.

Symptoms

The distribution of wheat streak mosaic is closely related to the dispersal of its mite vector. Margins of fields are commonly the first and at times the only areas affected. Although winter wheat is commonly infected in the fall, symptoms of wheat streak mosaic do not normally appear until the onset of warm weather in the late winter or the following spring. However, cereals that were planted in late summer or early fall occasionally show symptoms in the autumn. The first symptoms in the leaves consist of blotches and discontinuous dashes or streaks that are light green to a faint yellow. These areas are parallel to the veins. Later, growth of affected plants is retarded and leaves show a general yellow mottling, except for a few green streaks or blotches (Figure 1). Infected plants tend to spread out more than normal ones, frequently developing an abnormally large number of tillers. Some culms may grow to normal height and head-out, while others do not. Tillers in the same plant vary considerably in height (Figure 2). As the winter wheat plants mature, the yellow leaves tend to turn brownish and die. It is not uncommon to find stunted plants with sterile heads still standing after harvest – just the height of, or shorter than, the stubble.

Figure 2. Left, normal wheat plant; right, extreme dwarfing of a wheat plant due to virus infection.

In some fields, a high reduction in the yield and grade of the grain often results from complete or partial sterility and shriveled kernels. If infection occurs early with a severe strain of the virus, the plants may die before maturity. Synergistic effects are suspected between wheat streak mosaic and other cereal viruses, for example, barley yellow dwarf, soilborne wheat mosaic, wheat spindle streak mosaic, and several leafhopper-borne viruses. This makes the field identification of these diseases difficult or impossible. The symptoms of these viral diseases also vary greatly depending on the virus or virus strain, variety of wheat, temperature, time of infection, level of nutrition, soil moisture, and other factors.

Disease Cycle

The WSMV is transmitted from plant to plant by the feeding of all nymphal stages of the tiny (0.3 mm long), white, cigar-shaped wheat curl mite, ***Aceria (Eriophyes) tulipae*** (Figure 3). The mite vector feeds preferentially on the upper leaf surface and near the margin of leaves causing the leaf edges to curl tightly inward and upward toward the upper midrib. Such infected leaves tend to remain erect. The mites are enclosed protectively within the rolled leaves.

The mites thrive on the lush, young growth of wheat, barley, corn, millet, and many annual and perennial grasses (Table 1) where temperatures and predators are not limiting. The mites develop from eggs into adults within 8 to 10 days. Mite populations can increase markedly during relatively short periods when the environment is favorable.

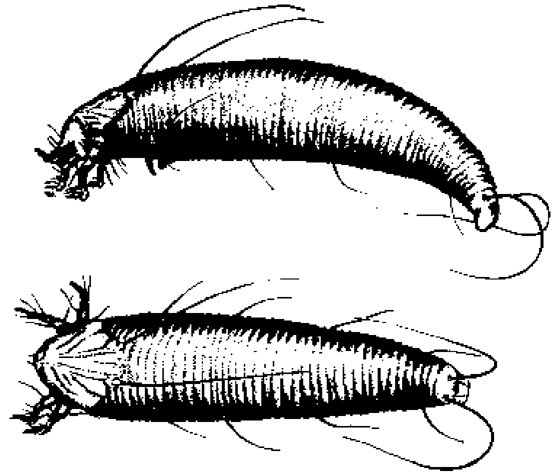

Figure 3. The wheat curl mite (Aceria tulipae), the transmitting agent of the wheat streak mosaic virus.

Only young (nymphal) mites can acquire the virus. They do this by feeding for 15 minutes or more on plants infected with the WSMV. The virus persists in most infective mites for 7 to 9 days when kept on virus-immune plants without additional acquisitions. The virus does **not** pass from the adult mite to its progeny through the egg.

Once a mite has picked up the virus from feeding on a virus-infected plant, the mite carries the virus in its body for one to several weeks. As winter wheat plants mature, the near-microscopic mites migrate into nearby volunteer wheat, barley, grasses, millet, or corn. The mite will carry the virus to these new host grasses, and may infect them. There is some evidence, though, that a few wheat strains of the virus will not infect certain fencerow or other grasses. Differences occur in host range among strains of the virus and species of closely related mites. Some grasses are hosts for the mites but not for the virus. Some are susceptible to the virus but are not good hosts for mites. Some accommodate both the mite and virus. Others are immune to both (Table 1). This situation may account for the differences in the host range of the virus and the vector – as well as the spread of the virus between grasses, corn, barley, wheat, and millet.

During the late summer and early fall, the WSMV is carried by mites from the grass and corn to volunteer wheat plants. In turn, the virus is later carried from volunteer to early planted wheat by the migrant mites. Wheat streak mosaic is severe when a series of lush, susceptible plants exists for both mite and virus between spring and autumn-sown crops. Late-maturing summer crops and volunteer stands of cereals from grain shattered by hailstorms or harvest operations also play an important role in completing the disease cycle.

The mites and the WSMV persist on wheat, barley, corn, millet, and susceptible perennial grasses such as buffalograss (***Buchloe dactyloides***) and foxtails (***Alopecurus*** spp). Strong winds can easily blow the mites at least 2.4 kilometers (1.5 miles).

Neither the wheat curl mite nor the WSMV can survive longer than a day or two if separated from a living host plant. There is some evidence that a small amount of transmission of the WSMV may occur in the field during strong winds through direct leaf contact between diseased and healthy leaves. With the ripening followed by the death of the plant, the virus is rapidly destroyed. No active virus has yet been found in dead plant remains or in the seed of diseased plants.

Infection depends upon three factors: the population of wheat curl mites; nearness of virus-infected plants, especially volunteer cereals; and moisture to help wheat or other cereal plants to grow vigorously where mites attain maximum reproduction. Wheat streak mosaic becomes a problem in barley, rye, sorghum, Sudangrass, foxtail millet, and broom-corn millet or proso only when mite populations build up to very high levels in nearby wheat fields.

Large populations of the wheat-curl mite built up on corn in 1966, 1987, and 1988. This development was associated with the red-streak disease reported in about 40 counties, mostly in northern Illinois.

Control

Control measures for wheat streak mosaic are aimed at destroying the populations of mites that transmit the WSMV and destroying the plants which are the virus source. This is best done by taking the following measures:

1. Destroy **all** volunteer cereals, old cereal stubble, and weed grasses in adjoining fields two weeks before planting, and three to four weeks before sowing in the field to be seeded. Doing this eliminates the mite vector as well as the mosaic-infected plants. The best control results when **all** wheat farmers in a community cooperate in destroying volunteer wheat and old stubble well ahead of planting time.

2. Sow winter wheat as late as practical – **after** the Hessian fly-free date or the latest recommended date – to escape migrations of the mite from corn, volunteer wheat or barley, or weed grasses. If winter wheat is not up until October or later, it usually escapes severe infestation, unless fall temperatures are above normal. An infection of winter cereals by wheat streak mosaic in the spring does relatively little damage.

3. No soft wheat currently recommended for use in Illinois is highly resistant to the WSMV. Disease reactions may vary from one locality to another and from year to year, depending on the physiologic races of the pathogens present. For the latest information on suggested crop varieties, consult your Extension office or the Department of Crop Sciences, University of Illinois, AW-101 Turner Hall, 1102 South Goodwin Avenue, Urbana, IL 61801.

4. Chemical control of the wheat curl mite has **not** been successful. The tightly rolled and trapped leaves provide a natural protection for the mite, preventing contact with miticides. It is also difficult to know exactly when to apply chemicals for control.

5. If wheat fields appear to be affected in a fairly uniform and severe manner by wheat streak mosaic in April or May, contact your nearest Extension adviser. Discuss with him or her the possibility of plowing under such fields and planting corn, soybeans, sorghum, or some other crop.

Table 1. Grass plants tested for suitability as hosts for wheat curl mite survival and wheat streak mosaic susceptibility

Common and Scientific Names	Increase of mites	Mosaic susceptible
A. CROP PLANTS		
Oats (***Avena sativa***)	none	yes
Barley (***Hordeum vulgare***)	poor	yes
Rye (***Secale cereale***)	poor	yes
Sorghum (***S. vulgare***)	fair-good[a]	no
Sudangrass (***S. vulgare*** var. ***sudanense***)	poor[a]	no
Corn (***Zea mays***)	poor-good[a]	yes
Foxtail millet (***Setaria italica***)	poor	yes
Broom-corn millet or proso (***Panicum miliaceum***)	none	yes
Wheat (***Triticum aestivum***)	good	yes
B. ANNUAL GRASSES		
Jointed goatgrass (***Aegilops cylindrica***)	fair-good	yes
Wild oats (***Avena fatua***)	none	yes
Japanese chess (***Bromus japonicus***)	none	yes
Cheat (***B. secalinus***)	good	yes
Downy chess (***B. tectorum***)	none	yes
Field sandbur (***Cenchrus pauciflorus***)	good	yes
Smooth crabgrass (***Digitaria ischaenum***)	fair-good	yes
Hairy crabgrass (***D. sanguinalis***)	none	yes
Barnyard grass (***Echinchloa crus-galli***)	poor	yes
Goosegrass (***Eleusine indica***)	none	no
Stinkgrass (***Eragrostis cilianensis***)	poor	yes
Teosinte (***Euchlaena mexicana***)	poor	no
Foxtail barley (***Hordeum jubatum***)	poor	no data
Witchgrass (***Panicum capillare***)	none	yes
Yellow foxtail or bristlegrass (***Setaria lutescens***)	none	no
Bristly or bur foxtail (***S. verticillata***)	poor	yes
Green foxtail (***S. viridis***)	poor	yes
C. PERENNIAL GRASSES		
Tall wheatgrass (***Agropyron*** sp.)	none	no
Western wheatgrass (***A. smithii***)	poor-fair	no
Slender wheatgrass (***A. trachycaulum***)	none	no data
Crested wheatgrass (***A desertorum***)	none	no data
Meadow foxtail (***Alopecurus pratensis***)	none	no
Tall oatgrass (***Arrhenatherum elatius***)	poor	no
Blue grama (***Bouteloua gracilis***)	none	no
Side-oats grama (***B. curtipendula***)	none	no
Grama (***B***. sp.)	good	yes
Smooth brome (***Bromus inermis***)	very poor	no

Common and Scientific Names	Increase of mites	Mosaic susceptible
Buffalograss (***Buchloë dactyloides***)	none	no data
Orchardgrass (***Dactylis glomerata***)	none	no
Canada wildrye (***Elymus canadensis***)	fair	yes
Indian ricegrass (***Oryzopsis hymenoides***)	poor-fair	yes
Switchgrass (***Panicum virgatum***)	none	no
Reed canarygrass (***Phalaris arundinacea***)	none	no
Canada bluegrass (***Poa compressa***)	poor	yes
Wheeler bluegrass (***P. nervosa***)	poor-fair	no
Bulbous bluegrass (***P. bulbosa***)	poor	yes
________ bluegrass (***P. stenantha***)	poor	yes
Johnsongrass (***Sorghum halepense***)	good	no
Indian grass (***Sorghastrum nutans***)	none	no
Sand dropseed (***Sporobolus cryptandrus***)	none	no data
Green needlegrass (***Stipa viridula***)	none	no data
Needle-and-thread (***S. comata***)	poor-fair	no data
Prairie sandreed (***Calamovilfa longifolia***)	none	no data

[a]Depending on the stage of growth and variety.