EC89-1871 Wheat Streak Mosaic Disease

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Wheat Streak Mosaic Disease

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- Symptoms
- Disease Cycle of Wheat Streak Mosaic
- Conditions Most Likely to Cause Epidemics
- Control

Wheat streak mosaic was first recognized in Nebraska in the early 1920's as "yellow mosaic." This virus disease has the potential to cause serious crop losses in winter and spring wheats and in spring oats. It is most prevalent in the central and northern Great Plains.

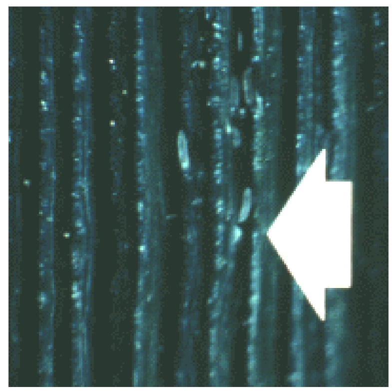

Figure 1. Wheat curl mite in the crease of a wheat leaf.

In Nebraska wheat streak mosaic commonly occurs in the west central and Panhandle, but also occurs in south central and eastern Nebraska. During some years the spring oat crop in northeast Nebraska is devastated by the combination of wheat streak mosaic and barley yellow dwarf diseases occurring in the same field.

Wheat streak mosaic is caused by the wheat streak mosaic virus (WSMV). This virus is a flexuous rod-shaped particle that can be seen only under high magnification using an electron microscope. Virus particles consist of a central core of ribonucleic acid (RNA) wrapped in a protein coat.

Viruses reproduce only in living hosts and require some type of carrier or vector to move from plant to plant. The vector for WSMV is the eriophyid mite, *Eriophyes tulipae* (K.) (*Figure 1*). This mite also is called the wheat curl mite. Spider mites and other mites that infest row crops, as well as the brown wheat mite, do not transmit the wheat streak mosaic virus.

Symptoms

The leaves of WSMV-infected plants show a yellow mosaic pattern of parallel discontinuous streaks (*Figure 2*). As symptoms progress, the leaves become mottled yellow. In the latter stages of symptom expression the yellowing may be so extensive that it can be confused with that caused by barley yellow dwarf virus.

However, WSMV-infected leaves usually retain the mottled, yellow-streak pattern, and the yellowing often is more intense than the pale-yellow color produced by barley yellow dwarf. Also, the yellowing caused by barley yellow dwarf starts at the tip and edge of the leaf, and expand toward the middle and base of the leaf, while wheat streak mosaic symptoms occur over the whole leaf.

Plants infected early in their life, i.e. early tillering or before, are stunted, discolored, and rosetted (*Figure 3*). They look similar to plants suffering from crown and root rot, except that the youngest leaves of virus-infected plants have a light green, dark-green mosaic pattern.

Figure 2. Streak mosaic pattern of wheat streak mosaic.

If infection occurs after the plants are well tillered, the stunting or rosetting symptoms may be subtle or nonexistent. The extent of stunting and rosetting in a field gives some indication as to the severity of the disease and ultimate yield loss.

Early infected, stunted and rosetted plants compete poorly with weeds, compared to healthy or late infected plants. The streaked mosaic pattern on leaves and the rosette appearance of plants are good field diagnostic characteristics.

Mite-infected leaves tend to remain erect with their edges rolled inward toward the mid-rib (*Figure 4*). The mites feed preferentially on the upper-leaf surface and near the edges. On a young plant the tip of a new leaf often is trapped in the rolled leaf immediately below it so that the developing leaf is curled back on itself, forming a loop (*Figure 5*).

Rolled and trapped leaves are good indicators of the presence of mites, and are useful in determining if stands of volunteer wheat are potential reservoirs of both the virus and the mite.

Infection of winter wheat often occurs in early fall, but symptoms usually do not develop until spring. As spring temperatures rise, symptoms become more visible and usually begin at the edges of fields or in areas where earliest infection occurred.

In most years there is a gradation of intensity of symptoms across a field, with the most yellowing on the side of the field adjacent to corn, wheat stubble, or areas with high populations of grassy weeds that were the source of the mites. In years with frequent windy weather, the mites will be spread throughout a field, resulting in a more uniform distribution of the virus.

Figure 3. Rosette symptom of wheat streak mosaic.

Figure 4. Rolled edge of wheat leaf due to feeding of wheat curl mite.

Figure 5. Trapped leaf of volunteer wheat due to feeding of wheat curl mite.

Disease Cycle of Wheat Streak Mosaic

The key to outbreaks of wheat streak mosaic on winter wheat is the presence of oversummering hosts on which virus-carrying mites build up to large numbers (*Table I*). In the central Great Plains the most important summer host is volunteer winter wheat that emerges before harvest, often as a result of hail storms.

Table I. Potentially important grass hosts[1] for wheat streak mosaic.

Common name	**Scientific name**
Wheat	*Triticum aestivum*
Oats	*Avena sativa*
Corn	*Zea mays*
Goatgrass	*Aegilops cylindrica*
Hairy grama	*Bouteloua hirsuta*
Downy brome	*Bromus tectorum*
Japanese brome	*Bromus japonicus*
Cheat grass	*Bromus secalinus*
Sandbur	*Cenchrus pauciflorus*
Crabgrass	*Digitaria spp.*
Barnyardgrass	*Echinochloa crusgalli*
Canada wildrye	*Elymus canadensis*
Virginia wildrye	*Elymus virginicus*
Stinkgrass	*Eragrostis cilianensis*
Witchgrass	*Panicum capillare*
Green foxtail	*Setaria viridis*
Foxtail millet	*Setaria italica*

[1]This list may not contain all grass hosts, but evidence has shown these grasses support both the wheat curl mite and the wheat streak mosaic virus.

Wheat is the preferred host for mites and wheat streak mosaic virus, although the mite also feed and reproduces on a few native grasses and certain grassy weeds.

Certain wild grasses probably are a source of sufficient virus-carrying mites to infect a small percentage of wheat plants. A few corn hybrids are susceptible to the virus, and many hybrids support high populations of mites under husks until early fall.

Some native grasses and certain grassy weeds are hosts to both the mite and wheat streak mosaic virus, but only a few permit increase of both virus and mites sufficient for epidemics.

In some years and in some locations, the native grasses and grassy weeds may supply enough virus-carrying mites to heavily infect adjacent wheat fields. Mostly, the native grasses and grassy weeds are reservoirs for long-term survival of mites and virus.

Jointed goatgrass, downy brome and Japanese brome, which are winter annual grassy weeds, can support both the virus and mites but have a life cycle similar to winter wheat. They mature before winter wheat, however, so they do not bridge the gap between winter wheat crops.

Of the summer annual grassy weeds, wheat streak mosaic virus routinely is found on barnyardgrass, stinkgrass, witchgrass and green foxtail; and, to a lesser extent, on sandbur, crabgrass and cheat.

The perennial grasses, western wheatgrass, smooth brome and buffalograss, are immune to the virus but are hosts for the mite. Hairy grama, Canada wildrye and Virginia wildrye support populations of both the virus and mite.

Theoretically, some of these grasses could have a significant role in widespread outbreaks of wheat streak mosaic. This rarely happens, however, and the grasses probably play a more important role in local outbreaks within a small geographic area where cropping or other conditions have created very weedy fields.

In the Panhandle and southwest Nebraska, lack of moisture causes the perennial grasses to go dormant most years during late July and early August. Localized outbreaks in Nebraska have been terraced occasionally to oats, foxtail millet or green foxtail growing adjacent to winter wheat.

The wheat streak disease cycle actually begins in the fall with the movement of mites from volunteer wheat and other grass hosts to emerged fall-planted winter wheat plants (*Figure 6*). The mite is wingless and webless and depends on the wind for dispersal.

In the fall as plants begin to dry out, mites leave the protected parts of plants, i.e. rolled leaves and whorls, and crawl to leaf tips or other exposed areas where they become wind-borne. If mites are carrying the virus, the young winter wheat plants become infected.

The earlier winter wheat is planted and the longer mild weather extends through October into November, the greater the spread and development of wheat streak mosaic. Under these conditions there is plenty of time for extensive secondary spread of mites and virus resulting in a high incidence of infection. Reproduction of the mite stops with temperatures near freezing.

There is evidence that warm weather in February and March can result in a further spread of mites and virus. The virus survives the winter within the plant, and the mites survive as eggs, nymphs or adults in the crown of the wheat plant.

As winter wheat greens up in the spring, the mites become active. The eggs hatch and the larvae acquire the virus as they feed on infected leaves. It takes only about 15 minutes for the mite to acquire the virus, and mites remain infective for seven to nine days.

The mites are wind-blown to other plants within the field. After landing, they crawl to the youngest leaf and begin to feed and reproduce. As wheat plants mature the mites migrate to the last remaining green tissue, which is the ripening grain. This is about the time the wheat is in the soft-medium dough stage.

If the grain is shattered before harvest by hail, the mites attached to kernels survive long enough to move on to the sprouting seedling. If moisture is insufficient and shattered kernels do not germinate within a few days, the mites die.

The mites and virus multiply rapidly through the summer on growing volunteer wheat. If July and August are hot and dry and volunteer wheat does not emerge until after harvest, it will have little or no virus or mites at first. However, some mites will survive on other grasses, grassy weeds or corn, and easily are carried by wind for several miles to infect either late volunteer wheat or early-planted winter wheat.

Severe infection usually develops only within one-fourth to one-half mile of volunteer fields or fields with high populations of grassy weeds. Spread is in the direction of the prevailing winds which usually are out of the southwest. The mites blow onto winter wheat in the fall soon after it emerges, completing the disease cycle. Early planted winter wheat can act as a source of mites and virus for fields planted at the proper time.

Although spring wheat is not a major crop in Nebraska, in recent years mites and virus have moved into spring wheat fields shortly after emergence. In some instances the infection has been widespread within a field, causing yield losses approaching 100 percent. Sources of mites and virus that infect spring wheat include winter wheat, volunteer wheat and other grasses.

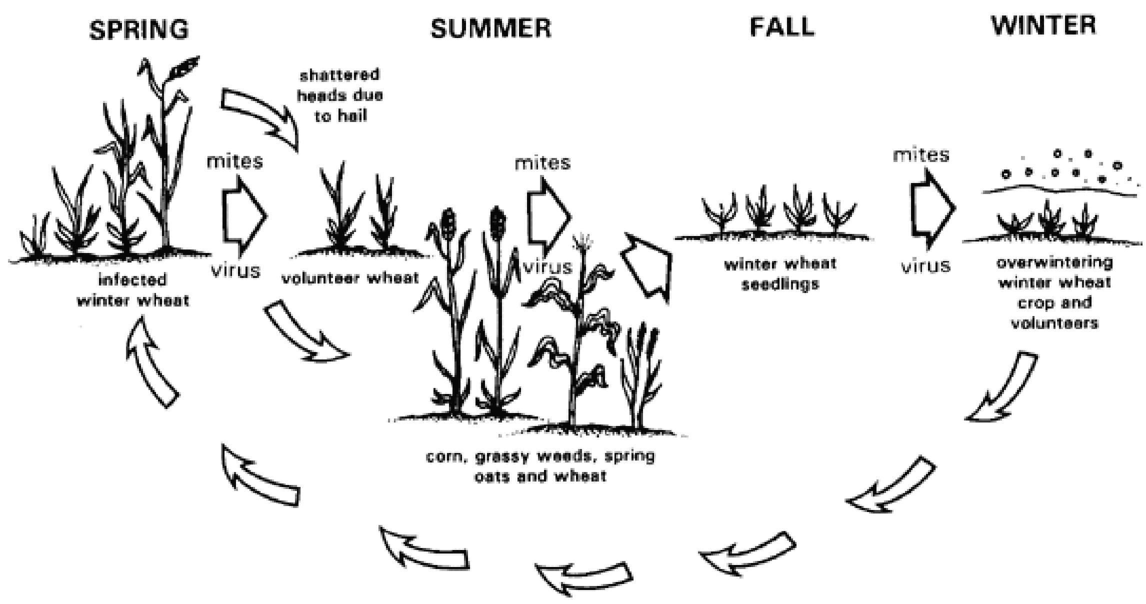

Figure 6. Disease cycle of wheat streak mosaic.

Conditions Most Likely To Cause Epidemics

- Hail storm when wheat is in soft dough stage, resulting in early volunteer wheat.
- Planting winter wheat 10 days to two weeks earlier than recommended for your geographical area.
- Poor weed control following harvest and in farm program acres.
- Cool, wet summers which encourage volunteer wheat and enhance mite survival.
- Warm, dry weather into November which promotes reproduction and spread of the wheat curl mite.
- Mild temperatures in February and March which, along with windy weather, increase the spread of the curl mite and virus.
- Use of oats or foxtail millet as a companion crop for spring-planted native grasses or farm program acres.

- Planting winter wheat in the corners of center pivot irrigated corn.
- Growing spring wheat and winter wheat in adjacent fields.

Control

Wheat streak mosaic is controlled by cultural practices that minimize sources of mites and the virus when winter wheat crops emerge in the fall. Prevention is the key to successful control — once the crop is infected, nothing can be done to correct the problem. Although there are no absolute guarantees when it comes to control of wheat streak mosaic, the following are the best preventative measures available.

- Do not plant winter wheat too early for your growing area. Plant at the proper date. Your local Extension educator can provide information on winter wheat planting dates for your area.
- Control volunteer wheat and grassy weeds that emerge before harvest. The volunteer must be killed either with tillage or herbicides at least two weeks before fall planting. A community effort of controlling volunteer wheat in stubble fields and along roadsides will be beneficial in mosaic-prone areas.
- Plant cultivars with greater tolerance to wheat streak mosaic. Consult your seedsman or Extension educator about cultivar response to wheat streak mosaic virus. Take time in June to observe a wheat cultivar trial in your area.
- Practice good weed control in stubble fields following harvest and in farm program acres. Preventing establishment of grassy weeds in farm program acres reduces potential reservoirs of the curl mite and virus. Oats used as a companion crop in Conservation Reserve Program fields should be planted early enough to mature before fall-planted winter wheat emerges.
- Avoid planting winter wheat next to late maturing green corn fields or late maturing oat fields.

Much of the control for wheat streak mosaic hinges on successful control of volunteer winter wheat and weeds in stubble fields and other areas. These are big users of soil moisture and nutrients. If soil moisture is available, they may use as much as three inches of soil water after harvest. Timely tillage and/or application of herbicides also will keep these weeds from producing seed. Moisture conservation and weed seed production especially are important if one is considering planting a crop in that field the next spring.

Several options are available. Most years sweep blades can be used immediately after harvest. The weather must be dry and hot to successfully use a sweep blade, as weeds must wilt within 30 minutes for good control. Usually, if you do not blade immediately after harvest, it is impossible to get the blade into the ground later unless moisture is received. Two bladings usually are necessary in the fall for good weed control, since the first usually plants weeds seeds.

Another option is to use herbicides. If no weeds are present after harvest, the best option is to wait until late August or early September and apply atrazine plus a contact herbicide if weeds and/or volunteer crops are present. In a three-year rotation when corn, sorghum or proso millet will be planted the next spring, the best option usually will be using herbicides after harvest and planting the crop no-till into the treated winter wheat stubble the following spring.

With the winter wheat-fallow rotation, the decision is more difficult. Factors to consider include farm program compliance, equipment availability, labor, herbicide costs, etc.

In general, if no weeds are present after harvest and most weeds can be controlled with one timely herbicide application, that application is probably the best bet. If weeds are present after harvest and two herbicide treatments must be used, the option of weed control with herbicides still may be economically feasible for the farmer who owns a sprayer.

For those without sprayers who have weeds after harvest, the best option may be to blade immediately after harvest and then blade again in late August or early September, and apply atrazine with the spray boom mounted on the blade.

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