PP-646 (Revised)

Wheat Streak Mosaic

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Figure 1. Infected plant showing yellowing and stunting.

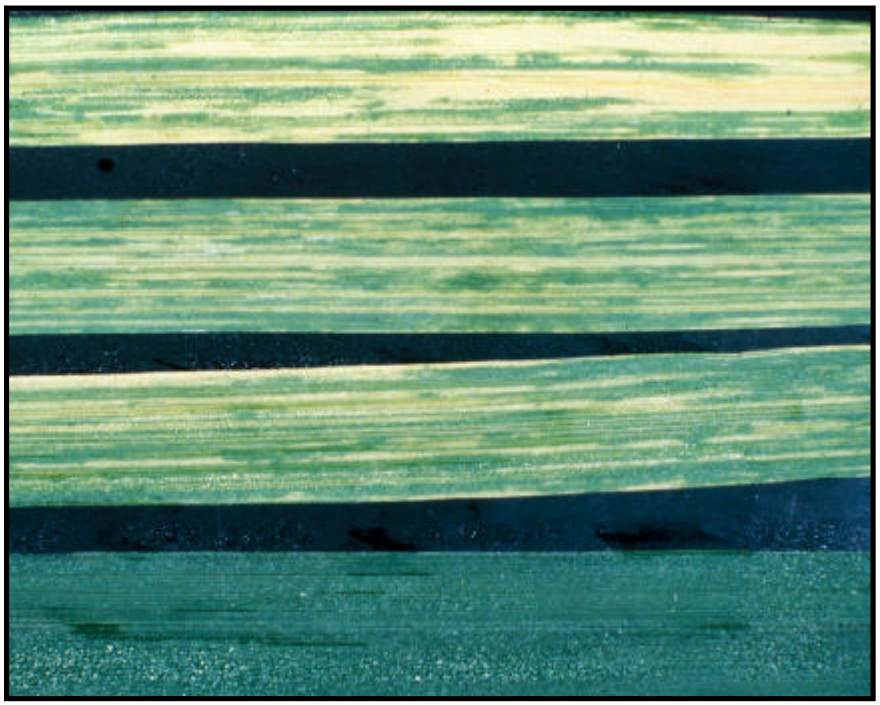

Figure 2. Yellow streaking and mottling on individual leaves. Bottom leaf is healthy. (Agriculture Communication, NDSU)

Wheat streak mosaic has the potential to be a very serious disease of both winter and spring wheats. Losses may range from slight to complete crop failure. Distribution may be restricted to a few fields, or the disease may be widespread. This disease is caused by the wheat streak mosaic virus (WSMV), and it usually occurs in areas of North Dakota where both winter and spring wheats are grown.

Symptoms, Losses

Symptoms of wheat streak mosaic often appear first at the edge of the field or in patches next to wheat volunteers. Under favorable conditions for development, the disease is soon observed throughout the field.

Infection of winter wheat often occurs in the fall, but disease symptoms may not appear until spring, when temperatures begin to increase. Infected plants have a general appearance of yellowing and stunting (Figure 1). If infection occurs early, the stunting is severe. Symptoms on individual leaves appear as discontinuous yellow stripes, streaks and dashes parallel to the veins (Figure 2). As the disease progresses, the leaves

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may become mottled, and eventually the yellowed leaves turn brown and die.

Yield loss is correlated with time and infection; the earlier the infection, the greater the loss. If plants are infected by early tillering (stooling), almost no growth occurs and few or no heads are produced. If plants are infected at late tillering to early jointing, heads are formed but florets may be sterile and little or no grain is formed. With late infection (jointing to boot), the heads are fertile, but the grain may have a low test weight. Yield losses generally are not severe in winter wheat unless the plants become infected in the fall.

Mites

WSMV can be spread mechanically through leaf rubbing, but it is primarily spread by the wheat curl mite, *Aceria tulipae,* a very tiny mite (less than 1/100 inch long) not visible to the naked eye. The wheat curl mite is white, cigar-shaped, and has four legs near the head (Figure 3). The mite has no wings but is carried by the wind from plant to plant and field to field, generally up to several miles. When large populations of the mite build up on wheat, the leaves curl so that the upper surface is rolled inward, hence the name wheat curl mite. In severe cases, the tip of the emerging leaf may be trapped as it emerges, so that it curves back upon itself.

The life cycle of the mite, from egg to adult, is completed in seven to 10 days. The mite requires green plants for feeding and reproduction. If no green food hosts are available after hatching, the mite does not survive. The mites reproduce most rapidly from 75 to 80 degrees Fahrenheit. Warm, dry conditions are most favorable for mite reproduction and spread. Reproduction stops at temperatures near freezing, but the mites can survive for several months at near freezing temperatures and for several days when temperatures are at 0° F. The mites overwinter as eggs, nymphs or adults in the living winter wheat crown or crown of other perennial grass hosts (Figure 4).

Hosts for Virus and Mites

Wheat is the preferred food for the mite and an excellent host for virus reproduction. However, the mite also feeds and reproduces on various other grasses, such as corn *(Zea mays)*, barley *(Hordeum vulgare)*, oats *(Avena sativa)*, foxtail millet *(Setaria italica)*, cheat grass *(Bromus secalinus)*, green foxtail *(Setaria viridis)*, Barnyard grass *(Echinchloa crusgalli)*, prairie cupgrass *(Eriochloa contracta)* and Canada wildrye *(Elymus canadensis)*. Repeated observations and serological tests with rye *(Secale cereale)* have not confirmed WSMV in this plant in North Dakota.

Grass hosts other than wheat primarily are reservoirs for long term survival of mites and virus, but severe outbreaks are almost always associated with volunteer wheat in which mites and virus have survived and multiplied (Figure 5). Cheat grass also has been associated with severe outbreaks of wheat streak in winter wheat in southwestern North Dakota.

Severe wheat streak mosaic has been found in winter wheat fields planted adjacent to late maturing corn. Green corn can become a feeding site for mites when adja-

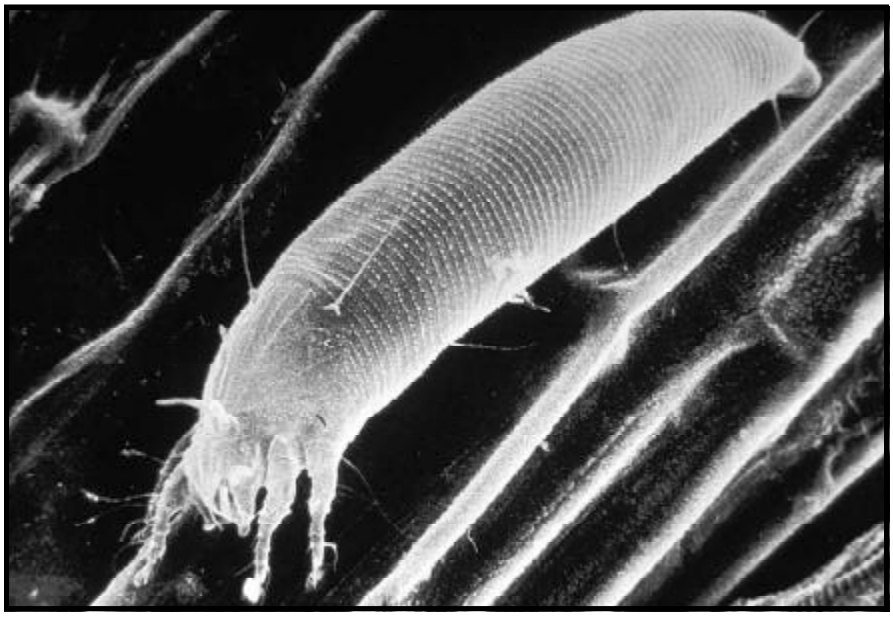

Figure 3. Wheat curl mite. (Electron Microscopy Laboratory, NDSU)

cent infested wheat fields mature. Red streaks on corn kernels may be signs of mite feeding on the kernels. As the corn matures in the fall, green tissue in the form of the newly emerged winter wheat seedlings is available for mite feeding.

Disease Cycle

Infection of winter wheat may occur in the fall if volunteer wheat, spring wheat, grassy weed hosts or corn plants infected with the virus and infested with mites are still green at seedling emergence of winter wheat (Figure 4). Volunteer plants may be in the same field or in nearby fields. Winter wheat planted into no-till wheat fields is particularly vulnerable if volunteers have not been controlled with herbicides. Mites are windblown from these sources to the winter wheat seedlings. If the mites are carrying virus, the young winter wheat plants will become infected. Early seeding of winter wheat favors WSMV epidemics. At early seeding, air temperatures are generally warm and the mites reproduce rapidly and have a longer time to build up on the emerged wheat seedlings prior to cold or freezing temperatures.

Infection of spring wheat depends on winter survival of the mite on winter wheat, volunteer winter wheat, or perennial grasses and on buildup of the mite population in the spring (Figure 4). Severe losses in spring wheat may occur if the crop is planted late near an infected winter wheat crop. Wheat curl mites prefer feeding on a green host. If the infected crop is turning yellow or brown due to disease or with maturity, the mites move to the top of the plant and position themselves to be readily carried by wind to green crops. Young, green spring wheat may be the crop the mite lands on, resulting in early infection and severe losses.

Hail frequently contributes to the wheat streak mosaic problem by causing head shattering before harvest. Grains knocked to the ground soon germinate, resulting in volunteer wheat that can sustain the mite and virus between green crops. This volunteer wheat, if not destroyed, can be a source of infection to winter wheat in the fall as well as to spring wheat the following spring.

Other factors that favor epidemics of the disease and severe losses include: 1) a wet August which favors continued germination and growth of volunteers; 2) a warm, dry fall and a warm, early spring, both of which increase mite survival, reproduction and movement.

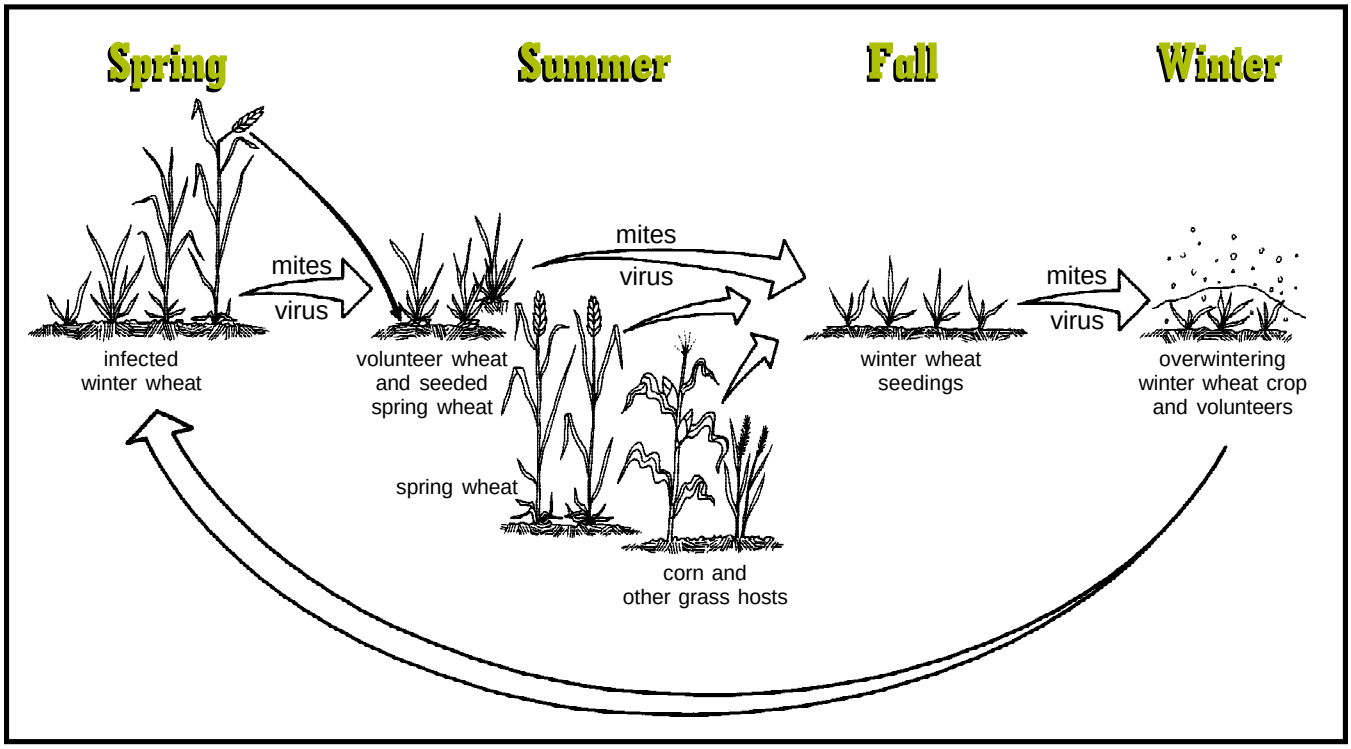

Figure 4. Wheat Streak Mosaic Cycle. (Agriculture Communication, NDSU)

Management

Control of wheat streak mosaic depends on breaking the life cycle of the wheat curl mite. This is primarily accomplished by managing volunteers and observing recommended planting dates.

Destroy all volunteer wheat plants and grassy weed hosts at least two weeks before planting winter wheat. Since the mites have to feed on green plants to survive, they will die during this two-week period. Volunteer wheat and grassy weeds can be destroyed either by conventional tillage or by use of chemical fallow herbicides. These chemical fallow or "knockdown" herbicides should be routinely used to destroy volunteers and weeds under no-till or minimum-till farming. Control of volunteers is most effective if practiced on an area-wide basis so sources of the mite and virus are minimized. Chemical control directed specifically at killing the mites or the virus has not proved effective.

Plant at the recommended seeding dates. *Winter Wheat:* Recommended seeding dates for winter wheat in North Dakota are September 1-15. A slightly later planting time (September 20) is possible in the southern part of the state or if winter wheat is seeded into no-till. Seeding prior to September 1 greatly increases the risks of severe losses from wheat streak mosaic. Early seeding also favors increased chances of root rot and winter kill in winter wheat. *Spring Wheat:* Avoid late planting of spring wheat near winter wheat that is maturing, as virus-bearing mites are likely to be wind-blown to the spring wheat while it is still young and especially vulnerable. Any volunteer winter wheat that escaped destruction in the fall should be destroyed at least two weeks before planting spring wheat. Wheat streak is less likely to be a problem on spring wheat if the cycle is broken in the fall.

Figure 5. Volunteer wheat with severe wheat streak mosaic infection.

Other management strategies: Avoid planting winter wheat next to green corn fields in areas which historically have had problems with wheat streak mosaic. In southeastern North Dakota, where winter wheat and corn have been frequently planted side by side, corn may become an important reservoir of the mite and virus. If it is necessary to seed next to corn fields, delay seeding until as late as possible and destroy all volunteer wheat.

All winter wheat varieties that are currently grown and winter hardy in North Dakota are susceptible to WSMV. Some less winter hardy wheats from states such as Nebraska and Kansas have shown some tolerance to WSMV, but their winter hardiness is the primary concern. Hard red spring and durum wheat varieties commonly grown in North Dakota also are susceptible but may vary in level of susceptibility. Currently (2002), North Dakota State University does not screen wheat cultivars for tolerance to WSMV.

For more information on this and other topics, see: www.ag.ndsu.nodak.edu

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