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Issue Article

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WHEAT DISEASES THAT AFFECT THE LEAVES, STEMS, AND STRIPES

Abstract: *Wheat rust diseases are one of the earliest plant diseases known, with their capacity to wipe out entire wheat crops. Studies have been done on the rust pathogens' life cycles and management, and best management practices have been created to lessen the effects of the diseases. The three rust illnesses that affect wheat are stem rust, leaf rust, and stripe rust, caused by Puccinia, a specific species of the "rust" fungus. Stem rust is a plant disease that causes pustules filled with thousands of dried yellow-orange to reddish-brown or black spores. It can also affect foliage, sheaths, glumes, awns, and seeds. Initial symptoms are reddish-brown nodules, while erumpent pustules release black sooty spores. Leaf rust can also affect glumes and awns. Seed heads may have tiny orange blemishes, but they don't grow into erumpent pustules.*

Key words: *diseases, leaves, stripes, plant, crops, fungus.*

Language: *English*

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Introduction

Wheat rust diseases are some of the earliest plant diseases that people are aware of. These terrible diseases and their capacity to wipe out entire wheat crops are mentioned in early writings on wheat cultivation. Numerous studies on the rust pathogens' life cycles and management have been done since the finding of rust. We have created best management practices that lessen the effects of the diseases thanks to the knowledge obtained from these studies. Today, global epidemic losses are uncommon, though the diseases can be very prevalent in specific areas or throughout a specific growing location. Specific traits of the rust fungi can be used to explain why rust continues to be a serious problem in wheat.

These traits include the ability to produce a lot of spores, which can be wild-disseminated over long distances and infect wheat in favorable environmental conditions, as well as the capacity to change genetically, resulting in the creation of new races with increased aggression on resistant wheat cultivars.

Stem rust, leaf rust, and stripe rust are the three rust illnesses that affect wheat. A specific species of the "rust" fungus, Puccinia, is the root cause of each of these illnesses. All rust fungi have comparable requirements for infection and exhibit similar disease symptoms on their host plants. The names of the illnesses come from how they show on plants. (Figure 1). Any portion of the plant that is above ground can become infected, producing pustules that are filled with thousands of dried yellow-orange to reddish-brown or black spores. These pustules give the plant the look of having "rust" on it.

Although it mostly affects stems, stem rust can also affect foliage, sheaths, glumes, awns, and even seeds. Oval to elongate nodules that are typically

reddish-brown in color represent the initial symptoms. Erumpent pustules release a lot of black sooty spores as the illness progresses. Plant stems may become weakened and lodge as a result of severe infections and numerous stem lesions.

Although it typically affects leaves, leaf rust can also affect glumes and awns. Small circular to oval yellow spots on infected tissue of the top leaf surface are the first signs of the disease. The spots turn into orange-colored pustules that may have a yellow halo as the illness worsens. (Figure 1). Large numbers of readily dislodged spores from the pustules are produced by the pustules, resulting in a "orange dust" on the surface of the leaf or on clothing, hands, and equipment.

Black spores may be generated as the disease worsens, causing a mixture of orange and black lesions on the same leaf. On seed heads, there may be tiny orange blemishes, but they don't grow into erumpent pustules. This distinction aids in separating stem rust from foliage rust.

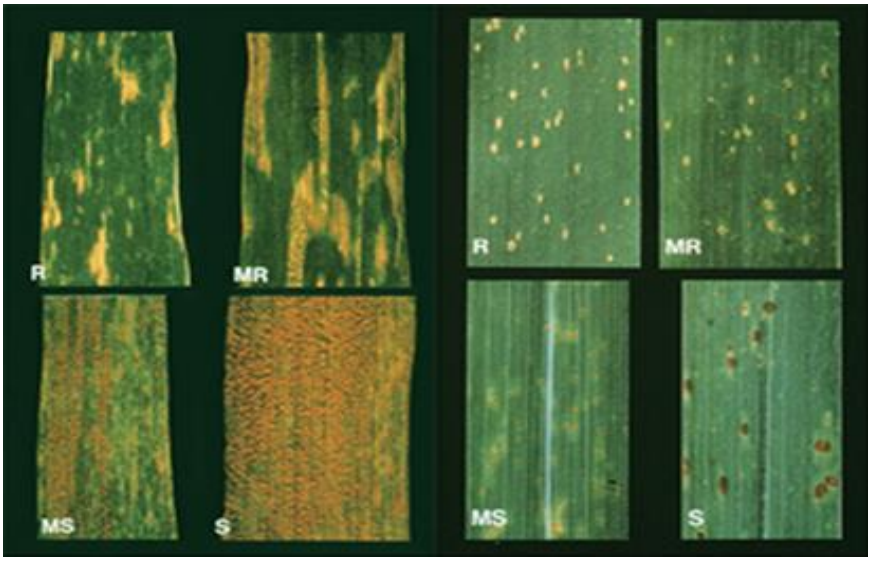

Figure 1. Relative resistances of wheat to stripe (left) and leaf rust (right): R = resistant, MR = moderately resistant, MS = moderately susceptible, and S = susceptible. Source: Rust Scoring Guide, Research Institute for Plant Protection, Wageningen, Netherlands. (Mark A. Marsalis and Natalie P. Goldberg)

Figure 2. Chlorosis of leaves caused by leaf and stripe rust infection. (Mark A. Marsalis and Natalie P. Goldberg)

The light golden, straight-sided pustules that appear in stripes on leaves and heads are what distinguishes stripe rust from other types of rust. These long, thin pustules come in different lengths. Spores that are yellow-orange are generated as the pustules develop. (Figure 1). The tissues surrounding the pustules become brown and dry as the illness worsens, giving them a scorched appearance. An essential feature that sets this illness apart is the organization of pustules into stripes. With both leaf and stripe rust, chlorosis, or yellowing of the leaves, can be quite obvious, and fields with plants exhibiting severe symptoms may be readily detectable from a distance. (Figures 2 and 3).

Puccinia graminis f. sp. tritici, also known as black stem rust, is the culprit behind stem rust. Although it can also cause minor infections on some varieties of barley and rye, the disease mainly affects wheat. Puccinia recondita f. sp. tritici is responsible for leaf rust. (now known as Puccinia triticina). While this pathogen, like the stem rust fungus, mainly affects wheat, it may also be weakly pathogenic to some varieties of barley, triticale, and some species of goatgrass and wheatgrass.

Puccinia striiformis is the culprit behind the third rust illness, stripe rust. More than 18 types of grasses are also impacted by this pathogen, along with barley, rye, and triticale. Stripe rust usually only affects wheat and barley crops, causing economic losses.

Figure 3. Variety of wheat susceptible to leaf and stripe rust, with noticeable severe leaf chlorosis, compared to tolerant varieties in adjacent plots with little or no leaf chlorosis. (Mark A. Marsalis and Natalie P. Goldberg)

These causative agents come in a variety of physiologic races with varying levels of aggression and pathogenicity toward different recipient plants.

Wheat cultivars with genetic resilience (or tolerance) to different rust races have been created by plant breeders. The extremely effective resistant cultivars have reduced the prevalence of many rust races that were common in the past. However, the pathogens' sexual recombination and mutation allow for the creation of new races. In order to create new cultivars with enhanced resistance to both new and old races of the pathogen, wheat breeders are continuously checking old cultivars for continued tolerance to the pathogen.

Rust fungi have intricate life cycles that may call for up to five different spore phases and two distinct host plants. There is usually an economic host and an alternate host for rust diseases that need two host plants to finish their life cycle. Wheat serves as the disease's fiscal host. Usually, a weed or natural plant serves as the alternative host. (Figure 4). For instance, the main alternate host for the stem rust fungus is barberry (Berberis vulgaris). On the underside of the leaves, infected barberry develops circular pustules that range in color from yellow to crimson. Wheat is infected by spores produced on barberry plants (aeciospores), and barberry plants are infected by spores generated on wheat (basidiospores).

Although the entire life cycle requires both hosts, epidemics on wheat can spread quickly because the spores (uredospores) produced on wheat can result in auto-infection. (spores infect the same plants on which they were produced). The repeating stage of the life cycle, or the spore stage, is what causes disease epidemics to spread quickly.

Meadow rue, rue anemone, and clematis have all

been found as potential hosts for leaf rust. There are no known secondary carriers for stripe rust. The rust fungus in this instance has a simplified life cycle that only requires one recipient.

The development of the disease requires water on the leaf surface from intermittent rains or heavy dews as well as temps that are favorable for the pathogen's germination and growth. Although it can happen at any temperature between 59 and 104°F, stem rust is a warm-temperature illness that thrives between 65 and 85°F. The ideal temperature range for leaf rust development is between 59 and 71°F, and the illness won't start to spread until the temperature is above 80°F.

Lower-temperature disease known as "stripe rust" is typically found at higher altitudes and in cooler climates. The ideal range for the onset of this illness is 50 to 59°F, with temperatures above 70°F halting disease growth.

When environmental factors are favorable for disease growth, infection is finished in 6–8 hours, and uredospores that can lead to secondary disease spread are created in 7–10 days. In comparison to other spore stages made by rust fungi, the viability of uredospores is comparatively short.

However, due to their widespread production and simplicity of wind dispersal, they are incredibly effective at spreading disease. It has been discovered that uredospores can endure all year long in regions with moderate winters. As a result, the pathogen's life cycle requires additional hosts and a few spore phases, but neither are necessary for the start of new infections every year.

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