

WHAT'S THAT ORANGE STUFF ON MY SHOES?

Dr. Tom Hsiang, Professor, Environmental Sciences, University of Guelph



Rust diseases on plants have been known since ancient times, and are one of the plant diseases alluded to in the Bible. In Genesis 41:27 it states, "seven empty ears (of wheat) blighted by the east wind are also seven years of famine." This passage has been interpreted to describe rust spores carried by moist winds which led to famines in ancient Egypt. The Romans even had a God of Rust, Robigus, who was honoured or placated annually by sacrifices of red coloured animals such as cows or dogs, red wine, and perhaps even red-haired humans.

Rust diseases have caused severe economic impact, and a severe outbreak of rust on coffee in the mid-1800s was probably responsible for changing Britain to a land of tea drinkers. Rust diseases are notorious on cereal crops, and world-wide losses to wheat stem rust are estimated at several billion dollars each year. The rust diseases on cereals are also the ones causing disease on turfgrasses. Rust fungi require living host tissue to feed upon, although spores can survive for at least a short period on the surfaces of recently dead plant tissues. Rusts are also highly specific to their host species, and a rust of perennial ryegrass may be unable to infect Kentucky

bluegrass, and vice-versa. In some cases, some rust varieties are specific to particular host cultivars, so that they cannot attack other plant cultivars even within the same host species.

There used to be a very popular garden plant called barberry which has attractive variegated foliage (Figure 1), and served very well as hedges since they have prickly thorns. But then they mostly disappeared from the urban landscape. What did the disappearance of this plant have to do with turfgrass rusts? Barberry was banned in 1966 for import into and trade within Canada. The reason for this was because barberry acts as the alternate host for the rust *Puccinia graminis* which causes stem rust of wheat and also rust on a variety of turfgrasses. The meaning of alternate host is that the fungus needs both the grass host and the alternate host to complete a full life cycle. Many attempts have been made to reduce the severity of rust diseases by eliminating the alternate host.

Rust fungi have among the most complicated life cycles of all living organisms, and there may be five distinct spore stages with two different host plant species required to complete a full cycle. Wheat farmers over 500 years ago first started to notice that wheat



FIGURE 1 Variegated barberry plant which was very common up until the mid-1900's but almost disappeared from the urban landscape because of efforts to eradicate wheat stem rust by eliminating this alternate host.



FIGURE 2 Buckthorn in late spring infected by the crown rust fungus. The spores produced in specialized small cups on this host can only infect turfgrasses such as perennial ryegrass.

rust was often worse when barberry bushes were growing nearby. This led to the eradication programs for alternate hosts. Did these eradication programs for the alternate host manage to break the life cycle and eradicate the wheat rust also? Not really, because not all barberry plants were eradicated, and mostly because, in North America, wheat rust can survive on living host plants near the Gulf of Mexico and then travel northward in springtime by wind and infect newly growing plants.

In this article, we'll look at the major rusts that attack cool season turfgrasses. We'll discuss their biology, and ways of recognizing and controlling these diseases on turfgrasses.

Hosts: Nearly all grasses can be affected by their own rusts, but among cool season turfgrasses, perennial ryegrass seems to be most greatly affected. Rust disease is also a problem on Kentucky bluegrass, but often only one species is affected in an area. All of these rusts also have their cereal hosts, for example, *P. graminis* on wheat and *P. coronata* on oats. However, as they are so specialized, the strain attacking the cereal may not be able to attack turfgrasses. The alternate host for *P. graminis* is barberry (Figure 1), and that for *P. coronata* is buckthorn (Figure 2). Orange spots are visible on these alternate host plants in the spring to early summer. The common rust on perennial ryegrass is called crown rust caused by *Puccinia coronata*. It is called crown rust, not because it attacks the crown of plants, but because the spores have protrusions that look like crowns (Figure 3).

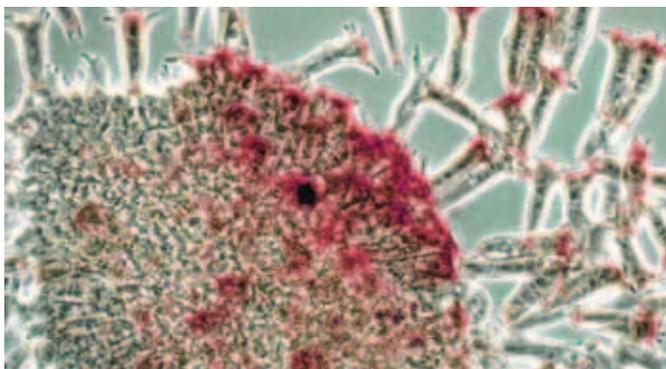


FIGURE 3 *Puccinia coronata* causing crown rust. It is called crown rust not because it attacks the crown of the plant, but because the spores have protrusions that look like a crown. (Courtesy of Dr. George Barron).

Season of Occurrence: Rust on turfgrass is most commonly visible on leaf blades in late summer into fall. However, the infections may start in late spring, and through several cycles of infection (from spores landing on the plant surface and penetrating into the plant, until these new infections produce new spores), the levels of rust can build up exponentially by the end of summer.

Conditions Favouring Disease: The conditions that are favourable for initial infection differ from those that encourage development of the disease in the field. Infection is favoured under moist conditions, but symptoms on the plants are favoured by dry or hot conditions where plant growth is slowed. Alternation of wet cooler weather with hot dry weather during summer will greatly enhance infection and allow disease levels to build up. In the later part of summer and into early fall, dry, hot, sunny conditions slow the growth of the grass, and also allow the rust to almost completely infect the entire leaf blades and produce abundant orange spores that can coat shoes, socks, and sports equipment.

Symptoms: The first symptoms on grass are small yellow flecks on leaves or sheaths or upper or lower leaf surfaces depending on the species of rust. Reddish-brown pustules (Figure 4) appear on leaf blades, bearing masses of summer spores (Figure 5). These rust spores can easily be rubbed off, giving a reddish tinge to shoes and equipment which commonly occurs in fields with lots of rust, but the yellow-orange spore producing structures are still intact

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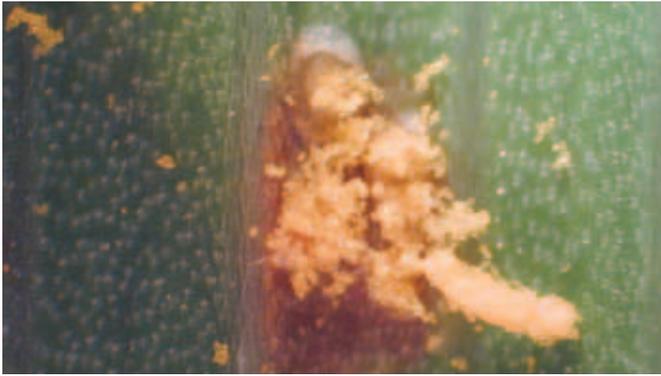


FIGURE 4 A yellow spot on a leaf blade caused by a rust is composed of the yellow plant tissue due to feeding by the rust, and the yellow-orange rust spores.

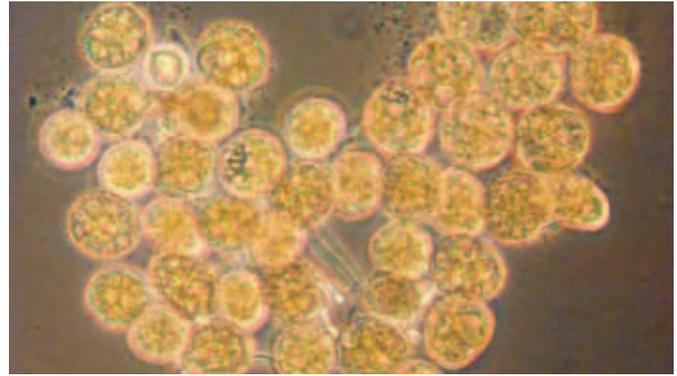


FIGURE 5 Rust spores are thick walled to withstand drying, and can travel long distances.

on the plant. These rust species are not known to be poisonous or produce toxins to animals, so occasional contact or even inadvertent ingestion shouldn't cause a health problem. Only aboveground plant parts are infected, and severe attacks may result in premature yellowing and shrivelling. After tissue has been killed or nearing the end of the growing season, brown or black spots composed of black winter spores may develop in place of the reddish-brown pustules (Figure 6).

Life cycle: Most rusts require more than one host species to complete a life cycle. In addition to the grass host, the other host, known as the alternate host, is usually a woody or herbaceous species such as barberry (Figure 1) or buckthorn (Figure 2). Typically the fungus overwinters on living or dead tissue of the grass host. If the fungus overwinters on living tissue, such as in areas of very mild winters, then there is no need to pass through the alternate host, and then the dormant mycelium will produce spores which serve as the primary source of infection in the following spring. This likely does not occur in northern latitudes including most of Canada because of the long winters.



FIGURE 6 Rust infections on perennial ryegrass later in the season. The rust has stopped producing the yellow-orange summer spores, and started producing the black winter spores which overwinter on dead grass foliage. The black spores will germinate in the spring to produce another short-lived spore that can only infect the alternate host, not the grass host.

In the spring, overwintering resting spores (teliospores) on dead grass tissue produce other spores (called basidiospores) which will only infect the alternate non-grass host. A few weeks after successful infection of this alternate host, another set of spores (called aeciospores) are produced in late spring or early summer which then infect the grass host. Infections on the grass host lead to production of pustules which bear many more spores (called uredospores) to re-infect grass (cycling stage which increases the amount of rust). As the grass host tissue dies off, another spore stage (usually black or dark brown and called teliospores) is produced on the grass tissue (Figure 6), and these structures overwinter to produce the next spore stage in spring.

Cultural Control: Mowing and managing fertility will usually control rust disease. If the grass is under irrigation, it should be watered infrequently but thoroughly early in the day to minimize leaf wetness periods and to avoid drought stress. Fertilization should be sufficient to avoid nutrient stress, and to improve leaf growth. Increased nitrogen fertilization may allow the plant to outgrow the disease so that infected tissues are mowed off before they have a chance to produce spores. Increased mowing height with greater frequency of mowing should also reduce disease symptoms, although some researchers recommend reducing the height of cut so that there is less foliage for infection. The drawback of this method is that the plant is weakened with a relatively smaller root system, and may be less able to fight off infection. Reducing shade and improving air circulation should lead to drier leaf surfaces and less opportunity for infection.

Chemical Control: No chemicals are registered for turfgrass rust disease control in Canada, but strobilurin and DMI fungicides have been found to be effective. Consult provincial publications and product labels for recommendations.

Resistant Turfgrasses: Cultivars of Kentucky bluegrass and perennial ryegrass with increased resistance to rust are available. Consult local publications or contact seed company representatives for lists of varieties. •

Except where noted, all images Tom Hsiang.