
Figure 1


Figure 2

# WHAT DO RUST DISEASES HAVE TO DO WITH TEA DRINKING, RED DOGS AND BARBERRY PLANTS?

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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 (Figure 2). The meaning of alternate host is that the fungus needs both the grass host and the alternate host to complete a full life cycle.

Rust diseases on plants have been recognized since ancient times and are one of the few plant diseases mentioned in the Bible. The Romans even had a God of Rust, Robigus, who was honoured annually by sacrifices of red coloured animals such as cows or dogs, and red wine. Rust diseases have had 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. Rust fungi require living host tissue to feed, although spores can survive on the surfaces of 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 isolates are specific to particular host cultivars, so that they cannot attack other cultivars even within the same host species.

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. Over 500 years ago, wheat farmers first started to notice that wheat rust was often worse when barberry bushes were growing nearby. This led to eradication programs for alternate hosts that were mentioned at the start of this article. Did these eradication programs for the alternate host manage to both break the life cycle and eradicate the rusts? Not really, because not all barberry plants were eradicated, and mostly because in North America, the rust can survive on living host tissue near the Gulf of Mexico and then travel northward in spring time.

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 turfgrass.

### 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 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 3). 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 (Figure 4) 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 5).

Figure 3

### Season of Occurrence

Rust on turfgrass is most commonly visible on leaf blades in late summer into fall. However, infections may start in late spring, and through several cycles of infection, the levels of rust build up 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 by low light intensity, 20 to 25ºC, and high humidity (e.g. long dew periods). After infection, disease development is enhanced by high light intensity, 25 to 35ºC, and dry leaf surfaces. Alternation of wet cooler weather with hot dry weather during summer will greatly enhance infection and allow disease levels to build up. In the last part of summer and into early fall, dry, warm and sunny conditions slow the growth of the grass, and also allow the rust to almost completely infect the entire leaf blades and produce abundant spores.

### Symptoms

The first symptoms on grass are small yellow flecks on leaves or sheaths on upper or lower leaf surfaces depending on the species of rust. Reddish-brown pustules (Figure 6) appear on leaf blades bearing masses of summer spores (Figure 7).

**Fig. 1:** Variegated barberry plant which was very common in the mid-1900s but almost disappeared because of efforts to eradicate wheat stem rust by eliminating this alternate host.

**Fig. 2:** Rust on Kentucky bluegrass surrounding a creeping bentgrass green in August. The creeping bentgrass is not susceptible to the Kentucky bluegrass rust and the thicker, more lush Kentucky bluegrass also contributes to more infection.

**Fig. 3:** 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.

**Fig. 4:** Crown rust of perennial ryegrass in late August causing widespread yellowing on a sports field. The yellow-orange colour comes both from the infected grass blades and the yellow colour of the rust spores and the bodies that produce the spores.

**Fig. 5:** *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.

**Fig. 6:** 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 4

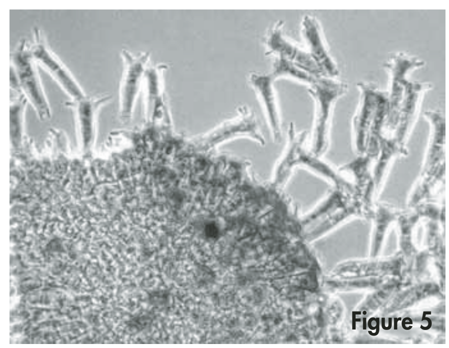


Figure 5

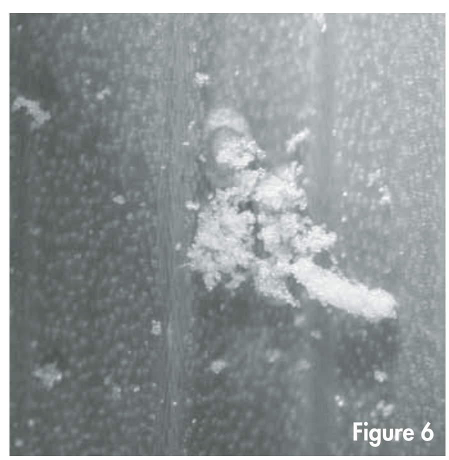
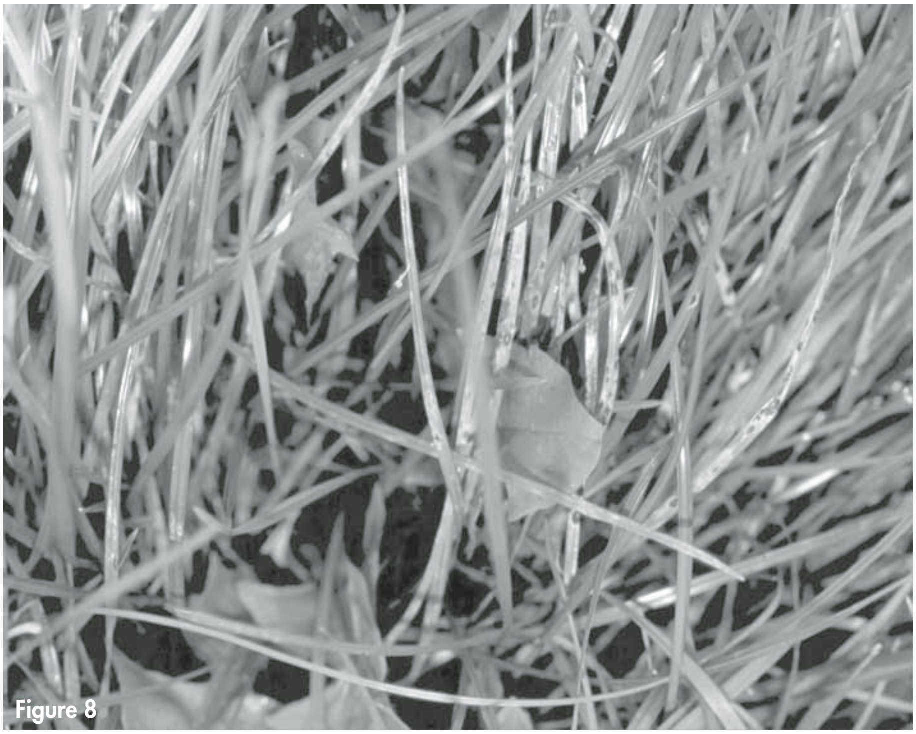


Figure 6



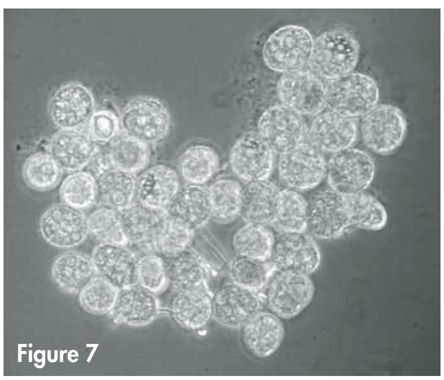




**Fig. 7:** Rust spores are thick walled to withstand drying and can travel long distances.

**Fig. 8:** Rust infections on perennial ryegrass later in the season. The rust has stopped producing the yellow-orange summer spore and has 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.

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. 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 above ground plant parts are infected, and severe attacks may result in yellowing and wilt. 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 8).

## 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 3). 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 the following spring. This likely does not occur in northern latitudes because of the severe winters.

In the spring, overwintering resting spores (teliospores) on dead grass tissue produce other spores (called basidiospores) which will only infect the alternate 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 8), and these structures overwinter.

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## Cultural Control

Mowing and managing fertility will usually control rust disease. The grass 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 mowing height with greater frequency of mowing should 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 in the U.S., azoxystrobin and propiconazole have been found to be very effective. Consult provincial publications 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. ♦