



Close up of leaves of Manhattan ryegrass being colonized by *Corticium* red thread pathogen.

# Recent Insights on the Nature and Control of *Corticium* Red Thread

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**C**ORTICIUM RED THREAD has the distinction of being the first reported foliar disease of turfgrass. The fungus that incites the disease was first observed on ryegrass in Australia, in 1854. The next account of an outbreak of red thread came from England, in 1873, where it was reported to be causing severe damage to ryegrass. The disease was first identified in the United States in 1931. At the present time, *Corticium* red thread is known to occur on bentgrass, bermudagrass, Kentucky bluegrass, creeping red fescue, and perennial ryegrass in the cooler humid areas of North America, Europe, and Australia.

Since the first description of the disease, all the symptoms associated with outbreaks of red thread have been thought to be caused by a single species of fungi. In recent years, however, research has shown that there are at least two fungus species that can cause similar symptom patterns on the grass they are infecting, and that they can occur simultaneously on the same stand of grass. Although both of these organisms produce pink mycelia and are in the same major taxonomic group of fungi, they are clearly distinguishable from each other. Also, while the symptom patterns of the diseases they inflict

on turfgrass have features in common, they also have certain key features that distinguish them from each other.

One of the components of what was formerly grouped under the blanket title of red thread is now known to be caused by the fungus *Limonomyces roseipellis*. Based on the primary features of its symptom pattern, this disease has been named *Limonomyces* pink patch. Only perennial ryegrass and creeping red fescue are known to be susceptible to pink patch. The disease is confined to the above-ground portions of the plant. Symptoms are usually seen first along the margins of the leaves where they

appear as small, irregularly shaped blotches of pink color bordered by light green to yellow bands of discolored leaf tissue. Eventually, the entire width of the leaf takes on a distinctive pinkish cast. When this occurs, a light brown to tan tip dieback of the leaves then develops.

On stands of grass that are mowed frequently and grow under optimum nitrogen fertilization, affected areas seldom reach more than 20 inches in diameter. Also, the severity of the disease within these individual locations is minimal. Consequently, under these management conditions, *Limonomyces* pink patch is generally regarded to be of minor importance. However, on turf that is mowed infrequently and that grows under low nitrogen fertilization, damage from pink patch may be severe. In these instances, the affected areas assume a distinctive pinkish tinge, after which all of the above-ground parts may become completely blighted.

From an economic viewpoint, the red thread component of this total syndrome is by far the most important. *Corticium* red thread affects a wider range of grasses than does *Limonomyces* pink patch, and it has a much greater potential for the destruction of large areas of turf.

A recent research report on the nature of the fungus that incites *Corticium* red

thread has recommended that its name be changed from *Corticium fuciforme* to *Laetisaria fuciformis*. The rationale for this change appears to be a valid one; therefore, the proposed new name for the fungus will probably receive general acceptance. However, for the sake of continuity in written and oral reports on the nature and control of the disease, its present standard name, *Corticium* red thread, should not be changed.

**T**HE PRIMARY diagnostic feature for *Corticium* red thread is the presence of fine, thread-like, coral pink structures 1/16 to 1/4 inch in length at the terminals of the leaves. These structures are never present in cases of *Limonomyces* pink patch. However, many of the other signs and symptoms of the two diseases overlap. Therefore, in field diagnosis, one can usually state with a reasonable degree of certainty that only *Limonomyces* pink patch is present. However, in the instances of positive diagnosis of the presence of *Corticium* red thread, one cannot be certain through field examination only that *Limonomyces* pink patch is not also present. This can only be determined by laboratory-based procedures. Whether or not only one or both of these diseases is present is more than just an academic question, for it could be the basis for

deciding whether or not a spray program should be initiated and what fungicides should be included in it.

Although the creeping bentgrasses have been known for years to be susceptible to *Corticium* red thread, the probability of the occurrence of the disease on putting green managed grass has not been given much consideration. One of the reasons for this is that the bentgrasses are one of the more resistant species to this disease. Also, outbreaks of red thread are most common when bentgrass greens are at their highest nitrogen levels and thus less prone to injury by the disease. In addition, in years past, the organic and inorganic mercury-based fungicides were a mainstay in greens management. These compounds are very effective in the control of *Corticium* red thread; consequently, the probability of the appearance of the disease was preempted as a side effect of standard fungicide application practices.

With the cessation of the use of mercury fungicides for control of diseases that occur during the growing season and the general trend toward lower nitrogen fertilization, the incidence of red thread on bentgrass greens has increased. In these instances, the disease has not been of any major consequence. However, it is capable of doing some damage to both the grass and the superintendent's confidence in his ability to control what he considers to be dollar spot.

Under close mowing conditions, the symptom pattern for red thread is somewhat different from that of taller cut grass. The affected areas range from two to six inches in diameter and are irregular in outline. The affected leaves are tan, and a cursory examination of the area can result in a misdiagnosis of the problem as being a case of fungicide-resistant atypical *Sclerotinia* dollar spot. In the instances of occurrence of *Corticium* red thread, however, close examination of the leaves will usually reveal the presence of a light reddish tinge to the sheaths. Also, although the frequency levels will be low because of the close mowing, the characteristic red threads typical of this disease can be found in these areas.

The optimum weather conditions for the development of *Corticium* red thread are air temperatures in the 68°-75° range, coupled with prolonged periods of rainfall. With creeping red fescue, soil moisture stress effects on the suscep-

*Overall view of Corticium red thread on Pennfinc ryegrass.*





*(Top) The positive diagnostic feature of red thread is the presence of fine thread-like, coral pink structures at the terminal portion of the leaves. (Above) Corticium red thread on Penncross bentgrass under putting green management. Note that the characteristic pink coloration produced by the red thread pathogen is present even under close mowing conditions.*

tibility of plants to the disease appear to be related to the variety in question. Rainier red fescue, for example, is more susceptible to red thread under conditions of low soil moisture content, while the susceptibility of the variety Pennlawn does not appear to be affected by soil moisture levels. Plants grown under calcium deficiency are more susceptible to red thread than those grown at adequate calcium levels. Of the various management practices, nitrogen fertilization has the most pronounced effects on development of this disease. The incidence of *Corticium* red thread is usually much lower when the plants are growing under a program of high nitrogen fertilization.

**O**F THE CULTIVATED turfgrass species that are susceptible to *Corticium* red thread, perennial ryegrass, creeping red fescue, and Kentucky bluegrass are most vulnerable. Within these species, there is a wide range in the degree of susceptibility among certain varieties; therefore, comparisons among species need to take this into consideration. However, as a general rule, the perennial ryegrasses rank at the top of the susceptibility list, with red fescues second. Kentucky bluegrasses, as a group, hold down third place. The increasing use of the fine-leaved perennial ryegrasses in recent years, then, has introduced a new dimension to the potential for outbreaks of red thread in areas where the disease has been known to occur but has not been considered to be of major importance. The eastern seaboard of the United States is a good example of this phenomenon. The past history of *Corticium* red thread in this region has been marked by occasional outbreaks of the disease, but not of sufficient magnitude to cause any general concern. However, with the steady increase in the use of perennial ryegrasses has come a higher frequency of reports of localized but severe outbreaks of red thread.

During 1982-83, in certain locations of Virginia, the disease was active in stands of ryegrass throughout the winter and continued to be in high incidence until late June. The year, then, was a particularly good one for comparative evaluation of the susceptibility of perennial ryegrass varieties to *Corticium* red thread. In the ryegrass variety trails at the Virginia Tech Turfgrass Research Center at Blacksburg, red thread was both severe and uniformly distributed over the plots for an extended period of

time. Comparative ratings of these plots were made for relative disease development, using an incidence-severity scoring system. The results were subjected to statistical procedures that identified the following comparative disease resistance groups:

	<b>Red Thread Resistance Group*</b>	<b>Perennial Ryegrass Variety</b>
<b>Most Resistant</b>	I	Linn Citation
	II	Derby Eaton Epic Yorktown
	III	Game Ensorta Pelo Diplomat
	IV	Pennfine Omega Manhattan Caprice
<b>Most Susceptible</b>		

\*The numerical values used to establish each of these rankings were subjected to analysis of variance, and the differences between groups are statistically significant at the 5 percent level of probability.

**I**N THE PAST, cadmium- and mercury-based fungicides were the principal compounds used for control of Corticium red thread. Although certain of the newer, organic fungicides have been shown in field tests to control the disease, from time to time reports of their performance does not correspond with the expected control level. The reasons for this could be such factors as differing levels of resistance to the modes of action by local strains of the red thread pathogen, or the possibility that the user is unknowingly dealing with both Corticium red thread and Limonomyces pink patch and the material in question is not active against one of the two pathogens. In any event, there is a clear and present need for an expanded program of field screening of candidate fungicides to search out those that are highly effective in control of red thread.

In the 1983 Virginia Tech field tests for red thread control, we included several fungicides that are presently commercially available for use on turfgrass, as well as recently developed compounds that are still in the early screening stage of development. Within the group of recently developed materials,

we found that certain of the ergosterol inhibitors show good promise for the control of this disease. Chevron's experimental sterol inhibitor XE-779 gave complete control of the disease. DuPont's DPXH6753 also gave a high level of disease control. The ergosterol inhibitors that are currently labeled for turf use [Elanco's RUBIGAN (fenarimol) and Mobay's BAYLETON (triadimefon)] also gave good disease control. Bayleton is presently labeled for red thread control.

Other compounds that gave very good control of red thread were Mallinckrodt's CADMINATE (cadmium succinate) and VORLAN (vinclozolin). Mobay's DYRENE (anilazine) and Ciba-Geigy's BANNER (propiconazole) were also very effective in control of the disease.

The future possibility of having a fairly wide selection of materials to choose from for red thread control looks very good. In the meantime, however, in view of the possibility of varying performance patterns in different localities and local regulations concerning fungicide usage on turfgrass, one should seek the advice of an established advisory service before initiating a spray program for the control of Corticium red thread.

*Effect of nitrogen fertilization on the incidence of red thread on Kentucky bluegrass. Left, low nitrogen; right, high nitrogen.*

