Biological Control of Turfgrass Snow Molds

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For the past six years, researchers at the University of Guelph have been working on a biological control system for turfgrass snow mold diseases. Work began in 1994 by looking for better strains of a fungus that could suppress gray snow mold disease caused by the fungi *Typhula ishikariensis* and *Typhula incarnata*.

Former Guelph professor Dr. Lee Burpee and Dr. Naoyuki Matsumoto in Japan had found that some strains of a fungus named *Typhula phacorrhiza* could inhibit gray snow mold disease. As a result, strains of *T. phacorrhiza* were collected from corn fields across southern Ontario. By 1997, five strains had been identified from several hundred that worked as well at suppressing gray snow mold as conventional fungicides.

In 1998, a new research phase began with funding from the Canadian Turfgrass Research Institute, Nu-Gro Corporation and the Natural Sciences and Engineering Research Council of Canada. As a result of the increased funding, the study was expanded to sites across Canada and more intensive work began on biological processes involved in suppression.

Although *T. phacorrhiza* can be found in abundance in corn fields after the snow melts in spring, the large majority of these isolates have little or no effect against gray snow mold. Since 1998, researchers have also tested and observed suppression of pink snow mold by *T. phacorrhiza*.

Work is continuing on developing ways of growing and formulating the inoculum of a select isolate of *T. phacorrhiza* (TP94671) that is antagonistic to both gray and pink snow mold, as well as studying the biology of their interactions. It is hoped that a granular product can be registered within two years that can be applied with conventional turf management equipment.

Snow Molds

The disease gray snow mold is caused by two species of fungi known as *Typhula ishikariensis* (with tiny dark black sclerotia) and *Typhula incarnata* (with small red sclerotia). The fungus *Microdochium nivale* causes pink snow mold. These diseases can be found on grasses and cereals and are common in areas with heavy and persistent snow cover.

In Canada, these diseases are typically controlled with fungicides containing mercury, quintozene or thiram. However, the cost of applying these synthetic fungicides, coupled with environmental concerns, has led researchers to investigate alternative management approaches.

Typhula phacorrhiza

The fungus *Typhula phacorrhiza* is a close relative of the organisms that cause gray snow mold. It is referred to as a saprophyte, which is a type of organism that lives on dead organic matter. It can be found in regions all over the world which typically have abundant organic matter (such as forest litter), and at least a few weeks of snow cover or near-freezing temperatures.

In Canada, this species is most commonly associated with corn stalk residue after snowmelt. It is a psychrophile, which means that it likes cold temperatures. Under laboratory conditions, the fastest growth rate for this organism is around 15°C. In many ways it is similar to the gray snow mold fungi, but it is not known to cause any turfgrass diseases. (Although it has been found to be associated with dead patches of grass after winter snow melt.)

Experimental results

In the first years of research, several hundred isolates of *Typhula phacorrhiza* were collected and tested in the lab for growth rate and production of resistant structures known as sclerotia. It is the sclerotia that allows this organism (and other organisms with sclerotia) to survive unfavourable conditions.

After winter field testing of some of these isolates, it was found that they have a large variation in their ability to suppress gray snow mold. However, in replicated and inoculated field trials, the most active *Typhula phacorrhiza* isolates are suppressive to gray snow mold caused by either *Typhula ishikariensis* or *Typhula incarnata*. These results were consistent in three years of field tests.

The residual efficacy of the best

Figure 1: Trial sites for winter 2000-2001 to test the control of snow molds by a select isolate of *Typhula phacorrhiza*.

Typhula phacorrhiza isolates was also examined, and after five years of field testing, it was discovered that a single application of *Typhula phacorrhiza* in the first year can suppress gray snow mold disease for the next three years to an aesthetically acceptable level. In the fourth and fifth years, although suppression was still evident in some plots, the level of suppression was not aesthetically acceptable and less than that of a fungicide check treatment.

Researchers also tested the fungicide sensitivity of select *Typhula phacorrhiza* isolates. The results showed that mycelia (fungal strands) are sensitive to all snow mold fungicides, but *Typhula phacorrhiza* mycelium is less sensitive to the fungicide Arrest® (thiram/carbathiin/carboxin) than *Typhula incarnata,* and less sensitive to Tersan® (benomyl) than the pink snow mold fungus. This means that an integrated disease management program could be developed that incorporates both the use of conventional synthetic fungicides such as Arrest® and Tersan® along with *Typhula phacorrhiza*.

Following the winter of 1999, researchers observed strong suppression of naturally occurring pink snow mold by *Typhula phacorrhiza* in trials near Barrie, Ontario. Although the suppression of pink snow mold by *Typhula phacorrhiza* had been observed in trials at the Guelph Turfgrass Institute, this effect was not specifically tested for since the main target in earlier research was gray snow mold.

In 1999, researchers set out to test the effect of *Typhula phacorrhiza* on pink

snow mold in replicated tests across the country. Unfortunately for snow mold fungi and for researchers, the duration of snow cover across most parts of the country has been lessening in recent winters,which meant snow mold disease pressure was not sufficient in most locations for a proper test of suppression.

However, excellent results were obtained from a golf course high atop the Rocky Mountains (Figure 2). Researchers had asked the staff to leave a 30m x 30m sward of creeping bentgrass fairway untreated in the fall of 1999 in order to test snow mold control.

In the back part of the test area (Figure 2) were fungicide trials with existing and new fungicides. The best suppression of snow mold by any fungicide in this test was less than 85 per cent, while some treatments showed little to no suppression of the heavy disease caused by both pink and gray snow molds in this area.

In the front of the test area, there was a separate small trial with *Typhula phacorrhiza* and three other treatments Only the four 1m x 1m squares of green are visible and these had been treated with *Typhula phacorrhiza* the previous fall.

On average, the disease control in the *Typhula phacorrhiza*-treated plots was over 97 per cent, while in untreated plots, there was heavy damage by both pink and gray snow molds. This again demonstrated that *Typhula phacorrhiza* could provide protection against very heavy disease pressure caused by both snow molds.

Since 1999, researchers have been working on a registration package for *Typhula phacorrhiza*. In order for a pest control product to be sold in Canada, it must be approved by the Pest Management Regulatory Agency (PMRA), which is part of Health Canada. The PMRA requires the following information in order to review whether a product should receive registration in Canada: product characterization; human and animal toxicology of product; environmental toxicology of product; and efficacy of product.

As for product characterization, genetic tests have been conducted with DNA, and growth rates and growth conditions have been measured for select isolates. This has enabled researchers to distinguish the best isolates from other closely related isolates and this allows them to track the fate and dispersal of the organism.

The toxicology of this organism (whether it causes problems for humans and animals) has not been studied in any detail. There are no reports of this organism or any closely related organisms causing harm to humans or animals. The requirement for full toxicological examination of biological control agents may be the major obstacle to their implementation since the costs are prohibitive.

There is already an abundance of details on the efficacy of this product particularly in southern Ontario, and this year's research will be expanded to sites across the full breadth of this country (Figure 1). Efforts have also been directed to investigating the biology of *Typhula phacorrhiza* as well as ways to produce it in large quantities. Hopefully, a granular product that can be applied with conventional turf management equipment will be available within the next couple of years. ♦

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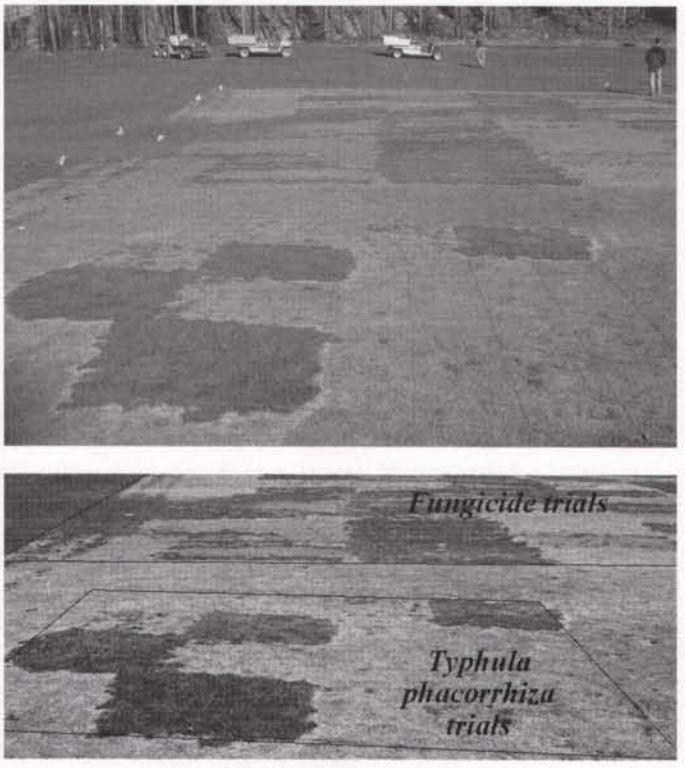

Figure 2: Snow mold trials at a golf course in the Canadian Rocky Mountains photographed on April 27, 2000. The plots in the background of both pictures are snow mold fungicide trials. The plots in the foreground are *Typhula phacorrhiza* trials composed of four treatments with four replications.