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PURPOSE

The purpose of *USGA Turfgrass and Environmental Research Online* is to effectively communicate the results of research projects funded under USGA's Turfgrass and Environmental Research Program to all who can benefit from such knowledge. Since 1983, the USGA has funded more than 350 projects at a cost of $29 million. The private, non-profit research program provides funding opportunities to university faculty interested in working on environmental and turf management problems affecting golf courses. The outstanding playing conditions of today's golf courses are a direct result of ***using science to benefit golf***.

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New Insights on Typhula Snow Molds

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SUMMARY

Researchers at Colorado State University continue to investigate the distribution and management of snow mold pathogens. Their findings include:

- Snow mold symptoms become apparent approximately 60 days after permanent snow cover and intensified significantly over the next 30-40 days.
- Compaction associated with the ski trails lowered temperatures at the soil/snow interface, often to temperatures below freezing, and inhibited snow mold development.
- Preliminary surveys indicate that *Typhula ishikariensis* var. *ishikariensis* is the predominant pathogen on the mountain golf courses above 7,000 feet. *Typhula incarnata* was most frequently isolated species from sampling locations below 6,000 feet in 2006-2007.
- All turfgrasses can be damaged to some extent by gray snow mold, but injury is often more severe on perennial ryegrass, bentgrasses, and annual bluegrass.
- *Typhula spp.* can vary in sensitivity to chlorothalonil.
- Although several biological control agents have shown promise as management tools for snow mold, a *Trichoderma* product did not provide any snow mold control on an annual bluegrass fairway in trials at Vail, CO (elevation 8,600 ft.) and only marginal control on a Kentucky bluegrass fairway at Breckenridge, CO (elevation 9,200 ft.).

Typhula snow molds, also called gray or speckled snow mold, are all too familiar to superintendents who manage golf courses in areas with long winters and heavy snowfall. These diseases develop under permanent snow cover and result in circular, straw-colored patches of damaged turf in spring. White fungal mycelium may be apparent on the matted, dead leaves as the snow recedes. Small, light tan to brown, spherical masses of fungal mycelium called sclerotia are embedded in the mycelium or leaves. Damage is related to the species of snow mold pathogen present, the turfgrass species affected, and the duration of snow cover.

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Disease Development

Growth of *Typhula* is favored by temperatures near freezing. Thus, long periods of snow cover that helps maintain temperatures at the soil surface just above freezing are ideal for fungal growth. In a recent study we found that the temperature at the snow/turf interface remained near freezing from late November through March in Breckenridge, Colorado. These conditions allow for snow mold growth while inhibiting other antagonistic microbes. We also found that snow mold symptoms became apparent approximately 60 days after permanent snow cover and intensified significantly over the next 30-40 days. Thus, snow cover exceeding 60 days increases severity.

There is a misconception that snow compaction caused by snowmobiles and skiers increases snow mold severity. We found that snow mold severity was almost non-existent underneath the Nordic/Cross Country ski trails located on the Vail and Breckenridge golf courses. We found that the compaction associated with the trails lowered temperatures at the soil/snow interface, often to temperatures below freezing, and

The #5 tee at Breckenridge where the Nordic Track Cross Country Ski Trail compacted the turf in the middle of the tee, reducing damage caused by snow mold. Gray snow mold damage can be seen on the edges of the tee where no compaction occurred.

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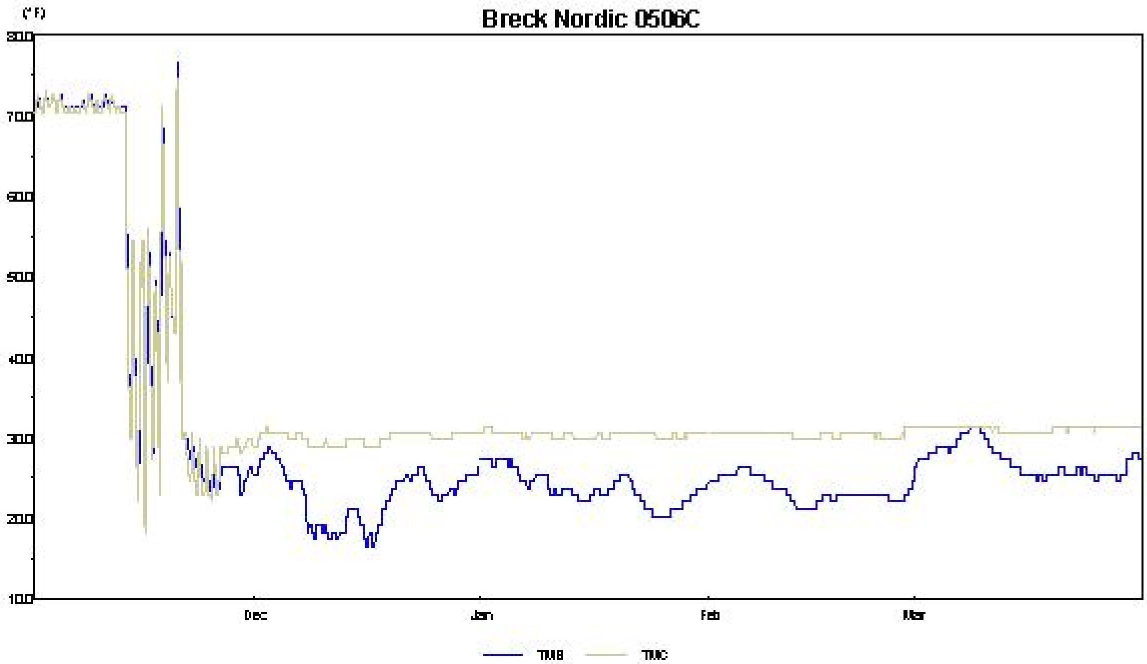

Figure 1. Temperature data from November through March 2006-2007at the Nordic Ski trail, Breckenridge Colorado. Note the that the temperature at the turf/snow interface in non-compacted snow (brown line) remained near freezing throughout the winter whereas the temperature under the Nordic track (blue line) fluctuated and remained below freezing most of the winter.

inhibited snow mold development. Thus, compacting snow on the golf course could potentially suppress snow mold without the use of fungicides. Unfortunately, compaction on the trails caused other significant problems including, soil heaving, irrigation pipe breakage, and slower turfgrass greenup.

There are two primary species of *Typhula* causing snow mold, and their distribution and frequency in a location is governed in part by the length of snow cover. *Typhula ishikariensis* causes a disease called speckled snow mold and tends to be more prevalent in areas with very long periods of snow cover (e.g. Canada, the northern Great Lakes region and the Rocky Mountain region). *Typhula incarnata* causes an almost identical disease called gray snow mold and is more common where snow duration is shorter. Because symptoms of the two diseases are so similar they are often lumped together and referred to as “gray snow mold” or *Typhula* blight. (5)

Product per 1000 ft^2	Plot area damaged (%) Vail	Plot area damaged (%) Breckenridge
Lesco 18Plus 4.0 fl oz + Manicure Ultra 82.5WDG 5.0 oz + Revere 12.0 fl oz	15b	1b
Daconil Ultrex 82.5WDG 5.0 oz + Lysone 200 ml	99a	15b
Plant Helper 0.68 fl oz FB Plant Helper 0.68 fl oz	92a	44a
Plant Helper 2.43 oz FB Plant Helper 2.43 oz	96a	21b
Untreated Control	81a	39a

Table 1. Comparison of Plant Helper to two fungicide treatments and untreated control from Vail and Breckenridge trials 2005-06. Means not followed by the same letter are significantly different P=0.05 by Fisher's LSD test.

Distribution of *Typhula* species

Part of our research has been to determine the frequency and distribution of Typhula species in Colorado. Our preliminary surveys indicate that *Typhula ishikariensis* var. *ishikariensis* is the predominant pathogen on the mountain golf courses above 7,000 feet. *T. ishikariensis* var. *canadensis* and *T. incarnata*, were also recovered although *T. incarnata* was sparse. However, *T. incarnata* was most frequently isolated species from sampling locations below 6,000 feet in 2006-2007. These data corroborate previously published information about the distribution of *Typhula spp*. in relation to snow cover duration, i.e. *T. incarnata* is more abundant in locales with shorter periods of snow cover. Information on the distribution of these *Typhula* fungi may influence management strategies for golf course superintendents.

Management

All turfgrasses can be damaged to some extent by gray snow mold, but injury is often more severe on perennial ryegrass, bentgrasses, and annual bluegrass. A recent greenhouse study demonstrated differences in susceptibility among creeping, velvet and colonial bentgrasses to *Typhula incarnata* and *Typhula ishikariensis* with velvet bentgrass the most susceptible (1, 2). It was also noted that as plants grew older, they became less susceptible to both *T. incarnata* and *T. ishikariensis*. This research suggests that bentgrass cultivars with increased snow mold resistance can be identified, but further field testing is needed.

Typhula snow molds are primarily controlled by a preventive fungicide application prior to permanent snow cover in autumn. Various fungicides and fungicide combinations are labeled for snow mold control and a detailed review of

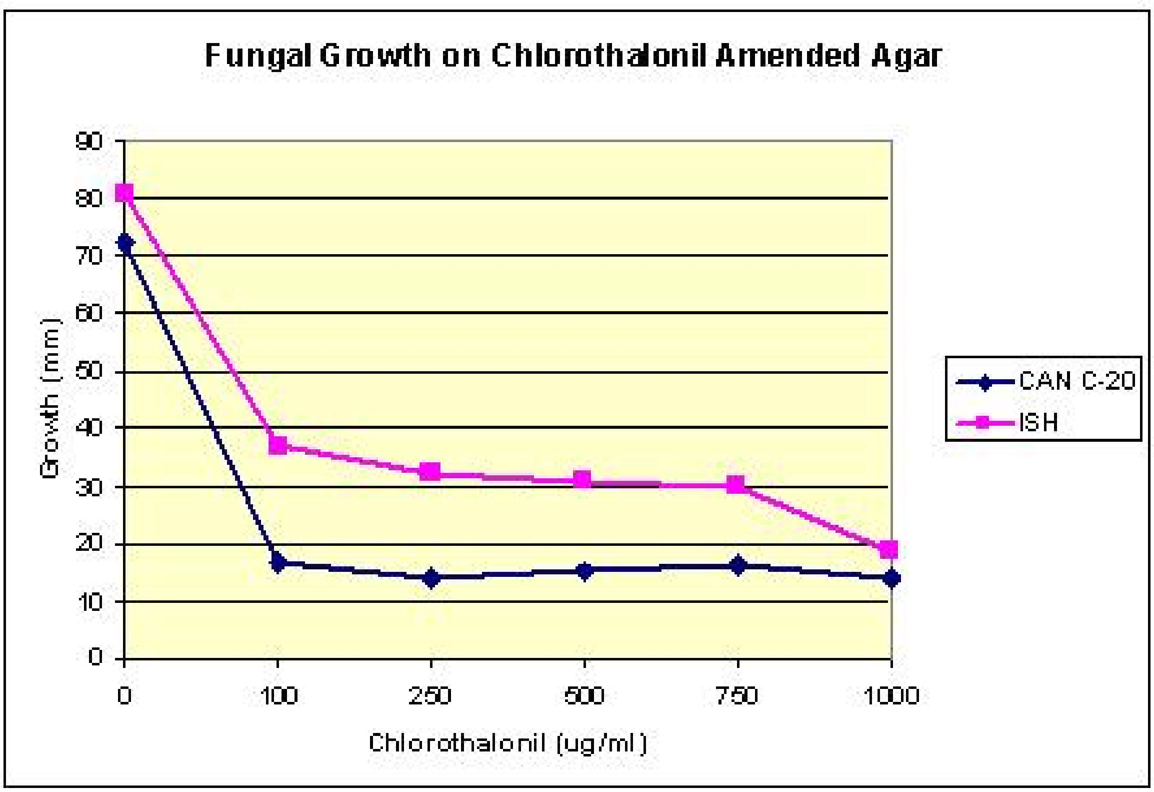

Figure 2. Growth of *Typhula ishikariensis* var. *ishikariensis* (pink) and *T. ishikariensis* var. *canadensis* (blue) on chlorothalonil amended agar. Mycelial growth significantly decreased between 0 and 100 ppm, but was still evident at 1000 ppm.

Product per 1000 ft^2	Area damaged (%)
26/36 4 fl oz + Endorse 4 oz	2e
Spectro 90WDG 4 oz + 26/36 4 fl oz + Daconil Ultrex 82.5 WDG 5.5 oz + SYNC	27d
Mustard Seed 1000 g one-day germination	51c
Oilseed Radish 1000 g one-day germination	85a
Rapeseed 1000 g one-day germination	80a
Untreated Control	56b

Table 2. Comparison of cruciferous seed to two fungicide treatments and untreated control from Vail trials 2006-07.

their efficacy will not be provided here. However, many of these fungicides fail to completely suppress snow mold development. One hypothesis is that fungicides are degraded or diluted during extended snow cover to the point where they are no longer effective.

We have evaluated persistence of chlorothalonil, a commonly- used snow mold fungicide, by periodically sampling and testing for residues through the winter. Our preliminary findings suggest that chlorothalonil concentrations decrease only slightly under the snow. Thus, a loss of chlorothalonil in the verdure does not appear to be the primary reason lack of efficacy. Instead, we observed that *Typhula spp.* can vary in sensitivity to chlorothalonil. For example, growth of two species of *Typhula* were inhibited but not completely suppressed at chlorothalonil concentrations reaching 1000 ppm. Thus, some mycelial growth, and consequently snow mold development, may occur even at relatively high chlorothalonil concentrations. We are currently testing the sensitivity of additional *Typhula* isolates to chlorothalonil and other fungicides.

Several biological control agents have shown promise as management tools for snow mold. *Typhula phacorrhiza* has shown efficacy by inhibiting growth of pathogenic *Typhula* species. (3) However it has not yet been successfully developed into a commercial product. The biological control fungus, *Trichoderma atroviride*, has been shown to control snow molds in trials in Alaska (4). This antagonistic fungus has been developed into a commercial product, but it is not labeled for use as a biological control for snow mold.

We tested the *Trichoderma* product in our trials, but the results were disappointing. The product did not provide any snow mold control on an annual bluegrass fairway in trials at Vail, CO (elevation 8,600 ft.) and only marginal control on a Kentucky bluegrass fairway at Breckenridge, CO (elevation 9,200 ft.). The applications of *Trichoderma* may need to be applied earlier than one would normally apply fungicides in order to allow the growth of the *Trichoderma*. This may increase the efficacy of the biological control.

Another intriguing control strategy was proposed by Tian and Hsiang (6). They demonstrated that applications of oilseed radish, canola seed, and mustard seed at 100g/m^2 and 500 g/m^2 to the turf in fall were as effective as PCNB in controlling snow mold in Canada. They hypothesized that the compounds isothiocyanates (ITCs) and glucosinolates (GSLs) produced by crucifers suppressed mycelial growth of snow molds. In our 2006-2007 trials, none of the crucifer treatments controlled snow mold.

Biological control of snow mold is research in its infancy. Although there are several biocontrol agents available, few have shown consistent efficacy against snow mold pathogens. As such, commercial development and registration of biological control agents are currently lacking thereby restricting their use on a scale large enough to accommodate the needs of the golf course superintendent. We will continue to include biological control methods in our research and look for biologicals that show promise for commercial development.

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Literature Cited

1. Chang, S.W., T. H. Chank, R. A. B. Abler, and G. Jung.2007. Variation in bentgrass susceptibility to *Typhula incarnata* and in isolate aggressiveness under controlled environment conditions. *Plant Disease* 91:446-452. (TGIF Record 123310)

2. Chang, S.W., T. H. Chang, L. Tredway, and G. Jung. 2006. Aggressiveness of *Typhula ishikariensis* isolates to cultivars of bentgrass species (*Agrostis spp.*) under controlled environment conditions. *Plant Disease* 90:951-956. (TGIF Record 112353)

3. Hsiang, T. 2000. *Typhula phacorrhiza* for snow mould control, 2000-2001. 2000 Annual Research Report, Guelph Turfgrass Institute, Guelph, Ont. (TGIF Record 91999)

4. McBeath, J.H. 2002. Snow mold-plant-antagonist interactions: survival of the fittest under the snow. The Plant Health Instructor. http://www.apsnet.org/online/feature/snowmold/ (TGIF Record 99178)

5. Smith, J.D., N. Jackson, A. R. Woolhouse, 1989. Fungal diseases of amenity turfgrasses, 3rd ed. E. and F. Spon, London. (TGIF Record 16673)

6. Tian, X, and T. Hsiang. 2006. Inhibition of snow mold fungal growth by glucosinolates in crucifers. Poster presentation. The American Phytopathological Society Annual Meeting, July 28-August 1. Quebec City, Quebec. American Phytopathological Society, Minnepolis, MN.