



An Assessment of Water Pressure Injection Cultivation in Treatment of Fairy Ring Fungi

By Robert Schmidt

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Introduction

This research project was conducted to assess the effectiveness of water pressure injection (WPI) cultivation in treatment of soil fungi that cause fairy ring in turfgrass. Cultural preparation of the affected area is essential before chemical treatments due to properties of the fungi that strongly inhibit soil saturation. The hypothesis behind this project is WPI may provide a means more effective than core aeration in circumventing the extreme hydrophobic nature of fairy ring fungi (FRF) by direct water penetration and physical movement of soil in the zone of mycelial development. Subsequent fungicide drenches will then be greatly enhanced in their ability to saturate the mycelial mass and suppress or possibly eradicate the fungal organism.

Background Information

Fairy ring symptoms in turfgrass occur world wide and are caused by numerous genera of soil inhabiting Basidiomycete fungi. FRF become established in a turf soil by transported mycelial fragments and/or basidiospores (Mallet and Harrison, 1987). Once established, mycelia move outward in a circular fashion at a rate of 3 to 24 inches annually, depending on soil type and environmental conditions.

FRF do not usually directly infect turfgrass plants, but cause indirect symptom development. Symptoms are typically described by three classifications. These are:

Type I: Death or severe browning of the turf occurs.

Type II: Turf growth is stimulated and very dark green, but shows no harmful effects.

Turf III: No visual effect on the turfgrass.

Type I rings are characterized by three distinct zones. An inner zone of turf stimulation, a middle zone where the grass is dead, and an outer stimulated zone (Smith, 1978). Zones of stimulation are caused by fungal breakdown of soil organic matter into ammonical compounds that are oxidized by microorganisms to nitrate and assimilated into the plants (Vargas, 1981).

The middle zone of brown turf is caused by several interacting factors that initiate turfgrass death. The dominant causal agent is the extreme hydrophobic nature of FRF mycelia; turf dies primarily from lack of water. Parasitic activity of the fungus (Bayliss and Filer, from Smith, 1980) and hydrogen cyanide released by fungal mycelia (Lebeau and Hawn, 1963) may also be factors.

Environment is a key factor as to the type of ring symptoms that develop. During cooler, wetter periods of Spring and Fall, established rings often display the less severe symptoms of Type II or even Type III rings. In Summer, higher soil temperatures stimulate FRF activity. This greatly reduces available water in the root zone. The combination of increased FRF activity and reduced root zones of Summer turf lead to rapid Type I symptom development.


The final factor in the severity of symptoms is the type of turf. Grasses such as bentgrass or Kentucky bluegrass, with relatively deep rooting and the ability to spread into bare spots, generally display less severe symptoms than a grass like *Poa annua* which is typically very stressed with minimal root system during Summer heat.

Various methods of control and/or management of FRF have been attempted. The most effective controls against FRF are also the most expensive and site disruptive. These methods require physical removal of affected soil and/or fumigation with volatile soil sterilants such as Vapam or methyl bromide. Biological control utilizing the self-antagonistic qualities of FRF is possible. When a soil heavily infested with FRF was thoroughly mixed, then replaced in the site it was taken from and re-seeded, fairy rings did not redevelop (Smith, 1978). To date, there have been no practical applications of such biological control.

Several chemicals have been studied for their effectiveness against FRF. These include crysilic acid, oxycarboxin (Baldwin, 1989), and benadonil (Heimes and Loecher, 1980). The effectiveness of these compounds generally relates to duration of symptom suppression. Variability in results tends to center on how thoroughly the affected soil can be saturated with the chemical.

Research Site

This research was conducted at Maple Bluff Country Club, Madison, Wisconsin. The fairy ring problem is not severe, yet it is persistent and predictable. Fairway turf is most affected by fairy rings. Fairways are an approximately equal mixture



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of creeping bentgrass and *Poa annua*, mowed at one-half inch. Fairy ring on fairways displays no more than Type II severity until regular, hot, dry periods occur, typically around mid-July. Then Type I symptoms often develop very rapidly. Soil in areas of fairy ring activity is often extremely dry even though directly adjacent to the fairy ring there is adequate moisture and healthy turf is present. Even soaking rains do little to wet areas with active FRF. Symptoms last into October when cooler, wetter weather occurs and the dead areas fill back in with *Poa annua*. Some fairy ring also occurs in rough areas populated by Kentucky bluegrass and *Poa annua*. Only Type II symptoms occur in areas where Kentucky bluegrass dominates. Where the rough is largely *Poa annua*, Type I symptoms occur regularly. Putting greens show limited fairy ring activity, and never greater than Type II severity. No fairy ring occurs on tees.

During the Summers of 1989 and 1990, fairy ring areas were drenched with flutolanil fungicide (FL) at a rate of 8 ounces/1000 square feet. (Flutolanil trade name is ProStar, chemical name is N-[3-(1-methylethoxy)phenyl]-2-(trifluoromethyl) benzamide.) This was done about every two weeks from late July through August. No soil cultivation was done before these treatments. These actions accomplished no more than minor, short term reduction in fairy ring symptoms.

Procedures

Fairy ring sites used in the study are outlined in Table 1. Selection of sites was based on the perennial presence of obvious severe fairy ring symptoms. Three plots (A,B,C) were set up to do a direct comparison between WPI and hollow tine (HT) cultivation. A control section of two foot width was placed between the treatment areas. Figure 2 shows the general setup used in plots A, B and C. The treatment area varied slightly in each plot due to inherent differences in ring size. Sites D through O were treated using WPI and FL only, with no control section.

Table 1.

Fairy Ring Site Description

Site	Location	Prominent Turf	Treatment
A	Rough	Kentucky Bluegrass	WPI/FL, HT/FL, Control
B	Fairway	Bentgrass/ <i>Poa annua</i>	WPI/FL, HT/FL, Control
C	Fairway	Bentgrass/ <i>Poa annua</i>	WPI/FL, HT/FL, Control
D-O	Fairway	Bentgrass/ <i>Poa annua</i>	WPI/FL

WPI: Water pressure injection cultivation

HT: Hollow tine cultivation

FL: Flutatonial fungicide

All sites were treated during the period July 21 to July 24, 1991. During this time, temperatures reached into the low 90's with high humidity. Soil conditions were very moist during cultivation due to substantial rainfall in the preceding 24 hours.

One section of sites A through C was cultivated with a Toro Hydroject set at minimal spacing, and two passes were made over each area. The hole spacing was 1 inch by 3 inches which was reduced further on the second pass. Depth of holes varied between 3 and 8 inches, with most in the 4 to 5 inch range. Hole diameter averaged about 1/8th of an inch at the surface. The other section of sites A to C was core aerified using a Toro Greens Aerator with 1/2 inch tines. One pass was made providing a hole spacing of about 3 inches to 2 inches. Depth of holes was about 3.5 inches. Plugs were

removed and no top dressing applied. ProStar was mixed with water at the highest label rate of 8 ounces/1000 square feet. Wetting agent was added to the mixture. The fungicide was applied as a drench by way of a garden type sprinkling can. One half of the mixture used per plot was distributed evenly over the entire area. The remaining half was then applied evenly over the turf area showing fairy ring symptoms, and 12 inches outward from the active symptom area. Fungicide was applied within 3 hours of cultivation to these sites.

Table 2.

Fairy ring responses to an application of 'ProStar' fungicide following water pressure injection or hollow tine cultivation.

Fairy Ring Symptoms			
SITE	INITIAL	1 MONTH	2 MONTHS
Water Pressure Injection Cultivation			
A	Type II	None	None
B	Type I Severe	None	None
C	Type I Severe	None	Type II Slight
Hollow Tine Cultivation			
A	Type II	None	None
B	Type I Severe	None	None
C	Type I Severe	None	Type II Severe
Control Section			
A	Type II	Type II	None
B	Type I Severe	Type I Severe	Type II
C	Type I Severe	Type I Severe	Type I Severe

Results

Qualitative evaluation of the success of these tests is based upon the degree of visible symptoms expressed and how they changed over time. Symptoms were evaluated at 1 and 2 months post treatment.

Site A: The WPI/FL and HT/FL sections initially showed symptom reduction not seen in the control section (Table 2). However, the overall dissipation of symptoms, including the control section, before the 2 month observations, make an evaluation of treatments inconclusive at this site.

Site B: Both WPI/FL and HT/FL areas showed complete symptom remission over the 2 month period (Table 2). A quicker re-establishment of turf was seen in the WPI/FL section. The control section showed continuous symptoms throughout the test period.

Site C: Complete symptom suppression was observed in the WPI/FL and HT/FL areas at 1 month post treatment (Table 2). At 2 months, the HT/FL section showed a redeveloped fairy ring that displayed Type II symptoms and migration of Type I symptoms a few inches inward from the control section. The WPI/FL area also showed some Type II symptoms, but they occurred in small, spotty areas unlike the cohesive semi-circle in the HT/FL section. The control section showed vigorous Type I symptoms throughout the test period. This site displayed symptoms of greater severity, when initially treated, than any fairy ring area on the golf course. The fact that the WPI area showed better long-term

symptom suppression than the HT area give indication that WPI either provided a more homogeneous fungicide saturation of the affected soil, and/or physical alterations of soil structure provided an environment less favorable to fairy ring development.

Sites D-O: Complete remission of Type I symptoms was observed over the 2 month period (Table 3). Thirty-three percent of these areas showed no further symptom expression. The remaining areas showed Type II symptoms of reduced size and severity.

Table 3.
Fairy Ring responses to an application of 'ProStar' fungicide following water pressure injection cultivation.

Fairy Ring Symptoms

SITE	INITIAL	1 MONTH	2 MONTHS
D-F	Type II, Some Areas Type I	No Type I, 50% less Type II	Very Reduced Type II
G-I	Type II, Minimal Type I Spots	No Symptoms	No Symptoms
J, K	Type I/Type II	No Type I, 40% Less Type II	Very Reduced Type II
L	Type I/Type II	No Type I, 40% Less Type II	Very Reduced Type II
M, N	Type I/Type II	No Type I, 40% Less Type II	Very Reduced Type II
O	Type II	No Symptoms	No Symptoms

Discussion

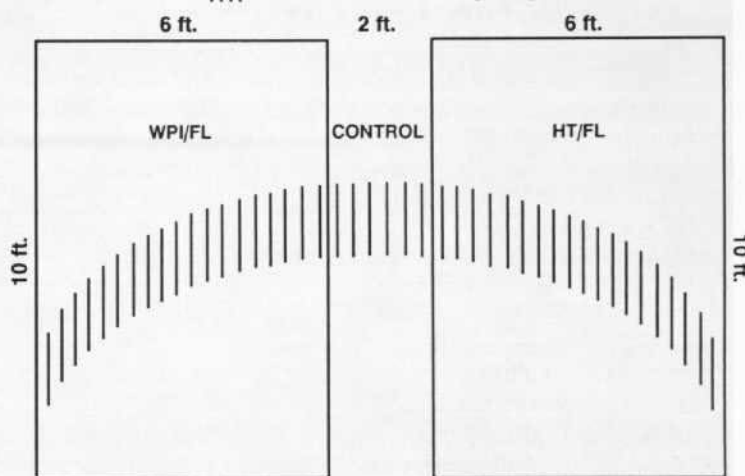
Based on test observations, WPI appeared to be very effective in suppressing Type I fairy ring development. When compared to the HT areas, WPI showed some advantages. With HT cultivation, there was slower recolonization of turf in dead areas, and, as seen in site C, reformation of an active fairy ring and migration of symptoms from the control section into the treated area.

The fungicide ProStar showed positive action in the suppression of fairy ring activity. No harm to turfgrass was seen using this product at its highest label rate.

To attain the clearest possible results, these tests were run primarily on fairy ring areas that showed severe Type I symptoms. However, in the treated areas with only Type II severity greater dissipation of symptoms occurred. This suggests that early treatment, before Type I symptoms develop, will result in more effective control.

The observations made in this study involved only visual symptom expression. Thus, there is no way of knowing whether eradication of FRF occurred or just suppression for

Figure 1. General Configuration of Plots A, B, C.
|||| Initial Position of Fairy Ring.



the current season. Regardless, the treatments were effective. Untreated fairy rings elsewhere on the golf course did not display reductions in symptoms similar to treated areas. These areas showed vigorous symptoms through August into early September.

Recommendations

For golf courses plagued with fairy rings, water pressure injection cultivation followed by a fungicidal drench is worth a try. Treat fairy rings before Type I symptom development when possible. Also, avoid WPI cultivation when soils are very wet. The Toro Hydroject, when operated on wet soils, was seen to press closed many of the openings it created at the surface. While no apparent variance in results was seen in the treated areas where this occurred, common sense says that open holes such as those observed in dryer soil, are more effective in getting fungicide into the primary zone of mycelial growth. Should it become possible in the future, the direct injection of fungicide with the Hydroject should be explored.

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