

Fairy Ring 101

The curious, elusive, but troublesome fairy ring.

BY MIKE FIDANZA, PH.D.

The “fairy ring” has long been a subject of folklore and legend dating back to pre-medieval times.^{2,21} In fact, the largest single organism on earth is actually a fairy ring-type fungus *Armillaria* sp., which has been slowly growing and decomposing oak tree roots in a 37-acre site in northern Michigan for nearly 1,500 years, and this humongous fungus is estimated to weigh 21,000 pounds.¹⁹ In turfgrass ecosystems, fairy ring symptoms are described as a circle or ring of mushrooms, lush green circular or semi-circular bands of grass, or rings or arcs of necrotic or dead turf.⁵

The fungi that cause fairy ring symptoms in turf belong to the basidiomycete or mushroom group, and these fungi grow and colonize the soil, rootzone, and thatch.¹⁸ In nature, these fairy ring fungi are known as wood-decayers, which means they enjoy a diet of lignin. Lignin provides strength to plant cell walls, is common in all higher plants,¹⁶ and is a major component of turfgrass thatch.³ In fact, lignin is the second most abundant organic compound on Earth after cellulose, which is the major component of turfgrass leaf blades.^{3,16} This may explain why fairy ring symptoms are often observed in turf near trees or in older native soil greens that contain buried tree stumps, other organic debris, and composts.

Fairy ring-causing fungi do not directly infect turfgrasses like other pathogens such as *Pythium* sp. or *Rhizoctonia* sp., but indirectly cause turf damage by disrupting the environment below the surface.⁷ As the fungus decomposes organic matter, its mycelium and other substances coat



Type-I fairy ring symptoms are the most severe and are associated with necrotic or dead turf.

the surfaces of sand and soil particles, contributing to the development of hydrophobicity or soil water repellency in the rootzone.^{9,12,14,15,17} With type-I fairy ring, the loss of turf and stand density is due to the detrimental reduction in plant-available water in the soil, the inhibition of nitrogen and other nutrients, and the accumulation of ammonium to levels toxic to plant roots.^{6,7,9,11} Elevated concentrations of ammonium and also sulfides in the soil rootzone correspond to a lack of bacterial activity needed to process those compounds due to the low soil moisture content and/or soil water repellency conditions.⁹ It is an interaction of all these factors that causes the grass to suffer. So, a combined knowledge of plant and soil sciences, biology, and plant pathology are needed to understand the fairy ring complex in turf and on your golf course. This knowledge can improve your control of this soil-borne, thatch-borne problem.

A COMMON PROBLEM

In the past, fairy ring symptoms may have been dismissed as a curiosity with minimal impact on the turf surface or interference with the game of golf. Higher nitrogen fertility rates, the use of maintenance products that contained banned heavy metals (cadmium- and mercury-based fungicides, for example), higher mowing heights, and irrigation practices were very helpful with masking fairy ring symptoms in turf.^{5,18} Today, a reduction in fertility practices, lower mowing heights, increased use of sand for topdressing and in new construction, and irrigation practices (i.e., longer wet/dry cycles) all contribute to the persistent appearance of fairy ring symptoms.^{7,9} A major concern is the development of soil water repellency and localized dry spot conditions often associated with type-I and type-II fairy ring symptoms, and scalping on greens associated with stimulated turf from type-II symptoms.^{4,6,7,9,13,14} Fairy ring symptoms are

commonly observed on new courses, newly rebuilt or renovated areas, and turf areas within one year after establishment, but also on older and long-established areas.^{5,7,18} Fairy ring symptoms in turf can be observed at any time of year, but they often occur during periods of hot/humid and dry weather, especially in turf that is under-fertilized.^{7,18} Truly, the fairy ring family of organisms is incredibly diverse and occurs over a wide range of environmental conditions. This is why the problem is so common here in the U.S. and worldwide. The argument could be made that fairy rings are the most common problem affecting golf turf worldwide, since these organisms are growing everywhere turfgrass is grown.

WHAT TO DO?

The unpredictable nature of fairy ring and its destructive impact on turfgrass frustrate even the best golf course superintendents. Some fungicide products are now available to treat fairy ring symptoms. Table 1 details currently labeled and soon-to-be-labeled products for fairy ring management. This is a good reference list to keep handy. After all, with fairy rings being such a problem, it is not a question of whether fairy rings will become a problem, but rather what to do when you get them.

In the research work done at Penn State, successful performance of those products applied in a preventive or curative program may be improved with the combined use of a soil surfac-

tant and a higher-than-usual water-carrier volume.^{4,5,8,10,13} The extra water is important for coverage and to move the fungicide into the target area below the turf canopy.^{9,10} Spot aeration also can help.^{5,8} Lee Miller, graduate student at North Carolina State University (Raleigh, N.C.), under the guidance of Dr. Lane Tredway, currently is investigating fungicide application timing for symptom reduction in greens.²⁰

An ideal fairy ring control program would start with aeration (i.e., needle-tine the affected area) to help vent excess ammonium, which can damage grass, but more importantly to promote oxygen into the rootzone. Next, an application of a soil surfactant followed by a fungicide (either sequentially or in a tank mix) in 100- to 150-gallon water-carrier per acre and then watered in, is essential for control. Do not under-water or over-water these treatments, since one or two turns of the irrigation heads or a light syringe is helpful, if not essential, to move the material off the turf canopy and into the zone where the fairy ring organism is growing.^{5,8}

Be careful of those irrigation practices during stress times that over-wet or saturate the soil, as this can lead to wet wilt.¹⁸ Equally, enough water needs to be applied to avoid a hydrophobic rootzone that is difficult to re-wet.^{4,13,17}

FAIRY RING RECURRENCE

The recurrence of fairy ring symptoms on the same green or fairway year after year may warrant a preventive or proactive approach. Experience from the field and research from North Carolina State University suggests that spring applications of triadimefon (Bayleton 50WP) and tebuconazole (Lynx 2SC) can be helpful in preventing the onset of fairy ring symptoms.²⁰ "The DMI fungicides triadimefon and tebuconazole provide excellent preventative control of puff-ball fungi *Lycoperdon perlatum* and *Vascellum pretense* in golf course putting greens. Two applications

Table 1

List of fungicide products currently labeled for treatment of fairy ring symptoms in the USA.

Active Ingredient	Trade Name and Formulation	Manufacturer ¹	Remarks ²
Azoxystrobin	Heritage 50WG	Syngenta	0.4 oz., 28-day interval, 4 gal. water/1,000 sq. ft.
Azoxystrobin	Heritage TL	Syngenta	2 fl. oz., 28-day interval, 4 gal. water/1,000 sq. ft.
Azoxystrobin + Propiconazole	Headway 1.39EC	Syngenta	3 fl. oz., 28-day interval, 4 gal. water/1,000 sq. ft.
Fluoxastrobin	Disarm 480SC	Arysta	0.36 fl. oz., 28-day interval
Flutolanil	Prostar 70WP	Bayer	Preventive: 2.2 oz., 21-28-day interval Curative: 4.5 oz., 30-day interval
Metconazole	Tourney 50WDG	Valent	Label addition pending
Polyoxin-D	Endorse 2.5WP	Cleary	4 oz., 2-3 applications, 7-day interval, minimum 2 gal. water/1,000 sq. ft., include soil surfactant, irrigate 0.05 to 0.1 inch
Pyraclostrobin	Insignia 20WG	BASF	0.9 oz., 28-day interval
Tebuconazole	Lynx 2SC	Bayer	Label pending
Triadimefon	Bayleton 50WP	Bayer	1-2 oz., 14-day interval 2 oz., 21-day interval (<i>Poa</i> greens) (refer to label for preventive use instructions)

¹Arysta LifeScience, Research Triangle Park, N.C.; BASF, Research Triangle Park, N.C.; Bayer Environmental Science, Research Triangle Park, N.C.; Cleary Chemical Company, Dayton, N.J.; Syngenta Professional Products, Greensboro, N.C.; Valent USA Corp., Richardson, Texas.

²Product rate/1,000 sq. ft., application interval, and water carrier volume/1,000 sq. ft. as listed on the product labels. Refer to product labels for specific information and instructions for product use. This list may not be inclusive of all commercially available products.



Type-II fairy ring symptoms are described as stimulated plant growth as evidenced by circular bands of dark green actively growing turfgrass.

on a 30-day interval, beginning in spring when five-day average soil temperatures reach 55°F, have provided season-long control in many cases.”²⁰ The same results can be expected on tees and fairways. However, be mindful of possible interactions between DMI fungicides and plant growth regulators. For curative control, again, refer to Table 1.

Questions are always asked about the use of soil modification or soil amendments and fairy ring. Realistically, most golf courses have been on soil modification programs using core aeration and topdressing with sand. Has this made the fairy ring problem worse or better? It is hard to say. Equally, the same could be said for soil amendments. Results from the field have been variable where superintendents have spot-treated or injected with inorganic soil amendments. Is the fairy ring being suppressed, or are the symptoms being masked? Again, it is hard to say. Research is ongoing to answer these questions about the way soil modifying products may or may not affect fairy ring. Interestingly, in rare occurrences, some superintendents have dug out and physically removed the fairy ring-affected area. This is a disruptive, time-consuming, and messy chore, and it's questionable whether it provides a long-term cure. It is hard to

say. It does underscore just how frustrating this problem can become. Using chemical controls may ultimately prove to be a better option than a sod cutter or a shovel. In addition to fungicides and soil surfactant strategies, a soil nutrition approach to fairy ring control is now offered by 3Tier Technologies (Southlake, Texas), and similar kinds of products from Grigg Brothers (Albion, Idaho) and others are currently being tested. More information on those approaches to fairy ring control will become available soon.

THE BOTTOM LINE

Sometimes these various treatment programs work, and sometimes they do not. What works to successfully manage fairy ring on one golf course may not work on another golf course, or even at a different location on the same golf course. After all, there are potentially more than 60 species of fungi that have been associated with fairy ring symptoms in turfgrass,⁵ and these species likely vary in their sensitivity to fungicides.^{8,10,20} Although new research results will provide a glimpse into the elusive world of the fairy ring, there is still much to explore and understand about fairy ring in turf. Today's turf manager does, however, have more good options to manage this problem than existed a few years ago.

REFERENCES

1. Agrios, G. N. 1997. Plant pathology. Academic Press, New York, N.Y.
2. Arora, D. 1986. Mushrooms demystified. Ten Speed Press, Berkeley, Calif.
3. Christians, N. E. 1998. Fundamentals of turfgrass management. Sleeping Bear Press, Chelsea, Mich.
4. Cisar, J. L., K. E. Williams, H. E. Vivas, and J. J. Haydu. 2000. The occurrence and alleviation by surfactants of soil water repellency on sand-based turfgrass systems. *Journal of Hydrology*, 231-232:352-358.
5. Couch, H. B. 1995. Diseases of turfgrass. Kreiger Publishing, Malabar, Fla.
6. Fidanza, M. A. 2007. Characterization of soil properties associated with type-I fairy ring symptoms in turfgrass. *Biologia*, 62(5):533-536.

7. Fidanza, M. 2007. New insight on fairy ring. *Golf Course Management*, 75(3):107-110.
8. Fidanza, M., F. Wong, B. Martin, and S. McDonald. 2007. Treating fairy ring with fungicides, new soil surfactant. *Golf Course Management*, 75(5):121-125.
9. Fidanza, M. A., J. L. Cisar, S. J. Kostka, J. S. Gregos, M. J. Schlossberg, and M. Franklin. 2007. Preliminary investigation of soil chemical and physical properties associated with type-I fairy ring symptoms in turfgrass. *Journal of Hydrological Processes*, 21(17):2285-2290.
10. Fidanza, M. A., P. F. Colbaugh, M. C. Engelke, S. D. Davis, and K. E. Kenworthy. 2005. Use of high-pressure injection to alleviate type-I fairy ring symptoms in turfgrass. *HortTechnology*, 15:169-172.
11. Gelernter, W., and L. J. Stowell. 2001. Nitrogen in turfgrass health and stress. *PACE Insights*, 7(9):1-4.
12. Hallet, P. D., K. Ritz, and R. E. Wheatley. 2001. Microbial derived water repellency in golf course soil. *International Turfgrass Society Research Journal*, 9:518-524.
13. Kostka, S. J. 2000. Amelioration of water repellency in highly managed soils and the enhancement of turfgrass performance through the systematic application of surfactants. *Journal of Hydrology*, 231-232:359-368.
14. Rillig, M. C. 2005. A connection between fungal hydrophobins and soil water repellency? *Pedobiologia*, 49(5):395-399.
15. Roy, J. L., and W. B. McGill. 2001. Observations on the chemistry of organic materials in water-repellent soils. *International Turfgrass Society Research Journal*, 9:428-436.
16. Salisbury, F. B., and C. W. Ross. 1985. *Plant physiology*. Wadsworth Publ., Belmont, Calif.
17. Schlossberg, M. J., A. S. McNitt, and M. A. Fidanza. 2005. Development of water repellency in sand-based root-mixes. *International Turfgrass Society Research Journal*, 10:1123-1130.
18. Smiley, R. W., P. H. Dernoeden, and B. B. Clarke. 2005. *Compendium of Turfgrass Diseases*. APS Press, Minneapolis, Minn.
19. Smith, M. L., J. N. Bruhn, and J. B. Anderson. 1992. The fungus *Armillaria bulbosa* is among the largest and oldest living organisms. *Nature*, 356(6368):428-431.
20. Tredway, L., and L. Miller. 2008. Breaking the curse of putting green fairy rings. *Carolinas Green*: July-August 2008.
21. Wollaston, W. H. 1807. On fairy rings. *Phil. Trans. Roy. Soc. London*, 2:133-138.

MIKE FIDANZA, PH.D., *associate professor, Pennsylvania State University, Reading, Pa.* For more information on fairy ring, please contact Dr. Fidanza at maj100@psu.edu.