

Fairy Ring and Localized Dry Spot: Is There a Connection?

by Wendy Gelernter, Ph.D. and Larry J. Stowell, Ph.D.

Researchers have long been undecided about the relationship between two key problems frequently associated with one another on golf course turf: fairy ring, which is known to be caused by Basidiomycete fungi (fungi that produce mushrooms or puffballs) and localized dry spot (LDS), the cause of which is not well understood. There are several good reasons for the confusion surrounding these phenomena. First, there hasn't been much research done in this area, and of that, most has been done in the Eastern United States where conditions are quite different than they are in the arid southwest. Secondly, unlike most other diseases, where one fungus is known to cause a unique set of symptoms, fairy ring symptoms can be caused by over 50 different types of fungi. Similarly, so many different phenomena can cause dry spots on turf -- from poor irrigation coverage, to compaction and poor particle size distribution, to hydrophobic soil -- that it has been hard to characterize and to develop solutions to this problem. In this issue of *PACE Insights*, we will lay out what is known and what isn't known about the biology, management and relationship between fairy ring and LDS, with a special focus on some of the unique situations we have observed here in the southwest.

Fairy Ring Symptoms

The disease known as "fairy ring" occurs on all turf types, and on greens, tees and fairways. In the West, it is most common on bentgrass and Bermudagrass, and less common on annual bluegrass (*Poa annua*). Symptoms can vary widely, but two features are common in most locations -- the presence of fruiting bodies (mushrooms or puffballs) in a ring or rounded arc that can measure from 1 - 6 feet in diameter, and the stimulated growth of darker green turfgrass associated with the ring or arc. As fairy ring infestations develop from year to year, the size of the rings will increase, and symptoms can grow more serious, including one or more of those described below:

- presence of mushrooms or puffballs in rings or rounded arcs
- stimulated growth of dark green turf

- depressions in the turf due to thatch degradation; the fungal mycelium is actually using the thatch as its food source, and can cause significant reductions in the depth of the thatch
- water repellency, or hydrophobicity of the soil, due to fungal production of waxy materials and mycelia that coat the sand grains
- death of the turf, usually in a ring-shaped pattern, due to a variety of possible factors including drought stress, production of ammonia, or production of other toxic materials such as hydrogen cyanide.

Fairy Ring Biology

In the southwest, we find two types of fungi most frequently associated with fairy ring symptoms:

- *Agrocybe pediades*, which produces a little brown mushroom (cap up to 2 inches in diameter) on a pale colored stalk (2 - 3 inches high). Spores produced on the underside of the cap are dark brown in color, which distinguishes this mushroom from other species.
- *Bovista plumbea*, the fruiting body of which is a round (up to 1.5 inches in diameter) puffball, with a small patch of soil (held together by fibers) at the base. Spores are produced inside the puffball, and are light colored when the puffball first forms. As the puffball matures, it becomes dry and the spores inside become dark brown in color.

Although these two fungi are commonly found associated with grasses (Arora, 1979), they are not listed in any of the key turfgrass disease textbooks (Couch, 1995; Smith et. al., 1989; Vargas, 1994) that review fairy ring biology. This is probably because work on fairy rings has been conducted primarily in the eastern U.S. and in Europe where conditions favor the development of other fungal species.

How do these small, innocuous looking fungi cause the variety of symptoms described above? Fairy ring infestations usually begin when fungal **mycelium** (a mass of fungal filaments, known as

hyphae) is transported from a previously infected area. This transport may occur via use of non-composted wood-based or peat-based soil amendments, where fairy ring fungi naturally reside. Mycelium can also move from one location on the course to another via equipment. Much less frequently, fairy ring can also be transported via the spores produced on the fruiting bodies (mushrooms and puffballs). Once established, the mycelium grows outwards in all directions, forming a circle of ever-increasing size, and as it grows, it breaks down organic matter in the thatch, the plant and in organic soil amendments. When this organic matter breaks down, nitrogen (in the form of ammonia) is released, causing the areas of stimulated growth and darker green turf that is commonly associated with fairy ring.

The fairy ring mycelium grows fairly rapidly (ring diameter can increase several inches each year if left uncontrolled), and a succession of ever-widening rings of stimulated and/or dead turf and fruiting bodies can form over time as a result.

In the southwest, we have observed that fairy ring mycelia frequently occur primarily at fairly shallow depths -- typically at the thatch-soil interface, which classes these as **lectophilic** or **superficial** fairy rings. In contrast, the fungi responsible for other fairy rings can colonize the soil quite deeply, to depths of up to 20 inches, and are classified as **edaphic** fairy rings. The depth of the fungal mycelium can be important in your management program, as will be described below.

Fairy Ring Management

Until recently, there were no effective fungicides registered in California for control of fairy ring, and superintendents were forced to mask the symptoms of fairy ring (by utilizing a series of cultural practices in combination with wetting agents) rather than to attack the causative agent directly. When symptoms became unmanageable, the only recourse was to excavate the area and/or fumigate, both extreme and undesirable measures. The recent registration of the fungicide Prostar (flutolanil) and the imminent registration of Heritage (azoxystrobin) for control of fairy ring, however, allows superintendents to use management programs that attack both the symptoms and the cause of fairy ring, without disrupting or damaging the turf. At the PACE Turfgrass Research Institute (PTRI), we have conducted research on

fairy ring management since 1993, and have developed the following program based on our results.

- Make monthly applications of Prostar (6 oz/1000 sq ft) or Heritage (registration pending) (0.4 oz/1000 sq ft) when symptoms first appear. Discontinue applications when symptoms begin to fade.
- Post-treatment irrigation is not necessary if either *Agrocybe* or *Bovista* are the causative agents. This is because these fungi produce mycelia that grow within inches of the turf surface. If you are uncertain which fungus is active at your site, send a sample of the fruiting bodies in to PACE for identification.
- Consider the use of wetting agents such as Respond (UHS) or Primer (Aquatrols) to improve fungicide performance and to alleviate dry spot symptoms (see below).

Localized Dry Spot Symptoms

Localized dry spot (LDS) refers to a specialized condition caused by hydrophobic (water repellent) soils that develop 1 - 2 inches underneath the turf surface. As a result of the drought stress caused by this condition, irregular and/or circular patches of browning and dead turf develop. However, dry spots can occur on turf for many reasons other than hydrophobic soils, including:

- poor irrigation coverage
- competition from tree roots
- compaction
- excessive thatch
- steep, sloping grades

To determine whether you have LDS, determine if the areas underneath dying turf are really dry, by using a soil probe to pull cores from the affected areas and from nearby areas with healthy turf. Samples should be at least as deep as the turf roots. If the soil underneath the damaged turf has the same level of moisture as under the healthy turf, then LDS is not the cause of your problem. However, if the soil is drier under the damaged turf and you can rule out the conditions above, then you probably have LDS.

Localized Dry Spot Biology

LDS and hydrophobic soils develop due to the production of waxy materials and/or fungal mycelia which coat sand particles and make them water repellent. The waxy, organic materials (thought to be related to humic and fulvic acids) are normally not present at high concentrations on brand new sand greens, but as the greens age, they build up. They are believed to come from a variety of sources including breakdown products of turf itself (including thatch, roots and leaves) and of organic amendments. Several different microbes, including fairy ring fungi, are believed to produce these waxy materials as well. It is for this reason that textbooks and scientific articles have pointed to the frequent association of fairy ring and LDS in the same areas of the golf course. In our experience in the southwest, we have observed that LDS and fairy ring are always intimately connected. Based upon these observations, as well as with our research with fungicides such as Prostar and Heritage that control both fairy ring and LDS symptoms, it is our belief that LDS on southwestern golf courses is primarily caused by the same fungi that cause fairy ring.

Factors Contributing to the Occurrence of LDS

It is likely that all sand greens will experience LDS to some extent. However, there are some factors that encourage more rapid development of LDS on new greens including:

- use of coarse textured sand (0.5 - 2 mm diameter). This is due to the poor water holding capacity of coarser soils
- thick thatch layers are believed to harbor the microbes that cause LDS
- newer greens (6 - 18 months old) are most susceptible to LDS
- creeping bentgrass, followed by Tifgreen bermudagrass are the most likely turf varieties to suffer from LDS
- the use of organic amendments, such as peat, appears to encourage the development of LDS
- extended drying periods appear to increase the severity of LDS symptoms

Localized Dry Spot Management

Cultural practices are an important basis for LDS and fairy ring management. Recent research conducted by PTRI also indicates that the fungicides Prostar and Heritage not only control fairy ring, but also alleviate the symptoms of LDS. Based on this research, the program below was developed:

- maintain thatch thickness below 1/2" by regular verticutting, aerification and topdressing
- use wetting agents such as Respond or Primer to alleviate symptoms of LDS
- use fungicides such as Prostar (6 oz/1000 sq ft) or Heritage (registration pending) (0.4 oz/1000 sq ft) to control the fungi that contribute to LDS symptoms
- implement a spring cultivation program based on the actions below to reduce compaction, break up hydrophobic soil aggregations and improve turf health
 1. core aerify using 5/8 inch tines; remove the cores
 2. topdress with 1/4 inch dry sand that meets USGA particle size specifications (no organic matter)
 3. deep tine aerify to 9 inches using a vertidrain or similar tool
 4. drag sand into holes in 3 directions
 5. finish filling the holes via manual sweeping or power blowers

Where we go from here?

When using new products for the first time at your golf course, it is always advisable to test them, whether they are pesticides or wetting agents, in a small area first. And as always, leave one or more areas non-treated so that you can determine whether the new treatments had a positive, negative, or neutral effect.

A better understanding of fairy ring and LDS as they occur in the southwest, development of effective cultural practices, and the availability of fungicides and wetting agents have made effective management of these two persistent problems a possibility in the last few years. However, we still know of no way to eradicate these problems; we can only manage them. Therefore, vigilance and observation of early

symptoms are still critical to management of LDS and fairy ring.

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PACE Consulting
1267 Diamond Street
San Diego, CA 92109