

Fairy ring management: a straightforward approach

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Bottom line: Once considered a devastating disease, particularly of new bentgrass and bermudagrass greens, the integration of new field research and new products into turf programs has today made fairy ring management a relatively straightforward task. Fairy ring (as well as localized dry spot, with which it is frequently associated) is most prevalent on newer bentgrass and bermudagrass greens, tees and fairways, though *Poa annua* and other cool season turf types are occasionally affected. Light-textured soils and soils with heavy thatch layers are also more prone to attack. Effective management of symptoms can be accomplished through a combination of cultural practices targeted at thatch and water management (aerification, topdressing, wetting agents and hand-watering) and the use of fungicidal products such as flutolanil (Prostar) and azoxystrobin (Heritage). Curative control of established fairy ring infestations is difficult to achieve, and for this reason, the greatest success occurs when management practices are initiated as soon as fairy ring symptoms appear.



It's hard to remember now, but it wasn't so many years ago that a diagnosis of fairy ring foretold a long, difficult and ultimately unsuccessful struggle against this turf disease. With no effective products registered for control, 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.

Figure 1. Fairy ring symptoms caused by the puffball fungus, *Bovista plumbea*. Note the circular areas of stimulated, dark green turf growth, and the presence of puffballs that were smashed by mowers within the circle.



The registration of the fungicides Prostar (flutolanil) and Heritage (azoxystrobin) during the 1990's now allows superintendents to use management programs that attack both the symptoms and the cause of fairy ring, without disrupting or damaging the turf. Field research conducted over the past 10 years has also led to a better understanding of the optimal cultural practices for this disease – a quartet of activities

including regular use of wetting agents, aerification, topdressing and hand-watering. As a result, management of fairy ring has become a relatively straightforward and also non-threatening process. While it is difficult to completely eradicate the disease, we will describe in this issue of *PACE Insights* how damage from the disease can be dramatically reduced.

Figure 2. *Agrocybe pediades* produces small brown mushrooms (left), while *Bovista plumbea* produces white puffballs (right). These are common fairy ring fungi in many parts of the U.S.



Fairy ring symptoms: attacking turf from a distance

The fungi that cause fairy ring are unique among turf diseases, because they do not grow on or attack turf directly. Instead, they damage turf and interfere with playability by gobbling up the thatch layer and releasing nitrogen from it, which in turn leads to the creation of sunken rings, and areas of faster growing and darker green turf. Growth of fairy ring fungi also tends to “waterproof” soils, making them hydrophobic -- unable to absorb water, a condition that leads to drought-stressed turf. And some fairy ring fungi secrete chemicals such as cyanide, that result in formation of arc-shaped areas of dead turf.

Fairy ring occurs on all turf types, and on greens, tees and fairways. It seems to be most common on turf varieties that are heavy thatch formers -- bentgrass and bermudagrass in particular, and is less common on annual bluegrass (*Poa annua*). Newer, sand-based greens appear to be more susceptible. Symptoms can

vary widely, but one or more of the symptoms below are typical:

- the presence of fruiting bodies (puffballs as seen in Figures 1 and 2 or mushrooms as illustrated in Figure 2) in a ring, rounded arc or irregular pattern that can measure from 1 - 6 feet in diameter
- the stimulated growth of darker green turfgrass, also in a ring-like or circular pattern (Figure 1)
- depressions in the turf due to thatch degradation; in this case, the fungal mycelium is actually using the thatch as its food source, and can cause significant reductions in the depth of the thatch (Figures 3 &4)
- water repellency, or **hydrophobicity** of the soil; this phenomenon is not well understood, and may result for a variety of reasons – including fungal production of waxy materials that coat the sand particles and thus “waterproof” them, to the water repellent nature of the fungal mycelium itself
- death of the turf, usually in a ring or arc-shaped pattern, due to a variety of factors including drought stress, or fungal production of toxic materials such as hydrogen cyanide (Figure 5)

As fairy ring infestations develop from year to year, the size of the rings will increase, and symptoms can grow more serious.

Figure 3. Fairy ring fungi feed on the thatch layer, causing small dents in turf that interfere with playability. Darker green turf is the result of nitrogen that is released as thatch is broken down by the fungus.



Figure 4. Soil profiles from a bentgrass tee show the thatch degradation caused inside a fairy ring (left), as compared to the deeper thatch layer (right) that occurs outside the ring.



Figure 5. Fairy ring infestations can result in turf death, usually in an arc or ring shaped pattern, due to lack of water caused by hydrophobicity and/or the production of toxic substances by the fungus.



Zip-lock bags and diagnosing fairy ring

Frequently, several of the symptoms listed above may occur, but are difficult to confirm as fairy ring because fruiting bodies (mushrooms and puffballs) are not always present. To stimulate the growth of fungal fruiting bodies, use a soil probe to produce several small holes (a few inches deep) at the periphery of the damaged turf. If fairy ring fungi are present, fruiting bodies may appear within the holes in a few days to a few weeks (Figure 6).

Figure 6. Puffball produced by *Bovista* appeared a few days after a soil probe was used generate this one-inch diameter hole at the margin of the damaged turf.



Figure 7. Another quick test for the presence of fairy ring involves the use of that famous high-tech diagnostic tool, the zip-lock bag. Take a cup cutter sample from an area that you suspect is suffering from fairy ring infestation. Moisten the sample, then place it in the bag and seal it shut. After 24 hours, open the bag and look for the growth of cottony, white fungal mycelium – particularly in the thatch area, as illustrated in the photo above. The growth of mycelium in the thatch area is another good indicator that fairy ring fungi are responsible for the symptoms you are observing.



In some cases, though, these tests may not provide unequivocal answers. If you have any doubts about the presence of fairy ring fungi, it is always wise to send your sample to a trained diagnostician for confirmation of your hunches.

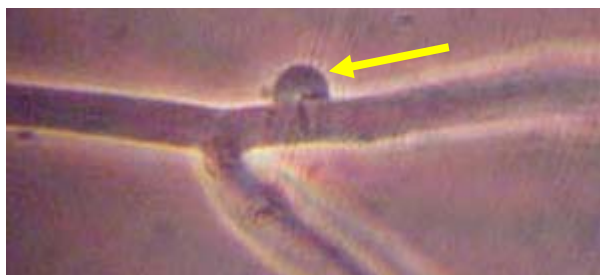
Fairy ring biology

The pathogen responsible for the symptoms described on page 1 is actually a large group of fungi – over 60 different species, by some estimates. In a given region, there are usually only two or three fairy ring fungal species that predominate.

Although they can look quite different from one another, all of the fungi that cause fairy ring belong to the same group of fungi – the basidiomycetes – and all share the following features:

- production, at some point in their life cycle, of fruiting bodies – usually in the form of either mushrooms or puffballs
- production of one or more of the symptoms described on page 1
- formation of microscopic structures known as **clamp connections** (Figure 8).

Figure 8. Under the light microscope, clamp connections (yellow arrow) formed by the hyphae of fairy ring fungi are a diagnostic feature.



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 thread-like, 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. 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 (Figures 1 and 3).

The fairy ring mycelium grows fairly rapidly (ring diameter can increase several inches each month 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. In contrast, the fungi responsible for fairy rings in other parts of the country can colonize the soil quite deeply, to depths of up to 20 inches. The depth of the fungal mycelium can be important in your management program, as will be described below.

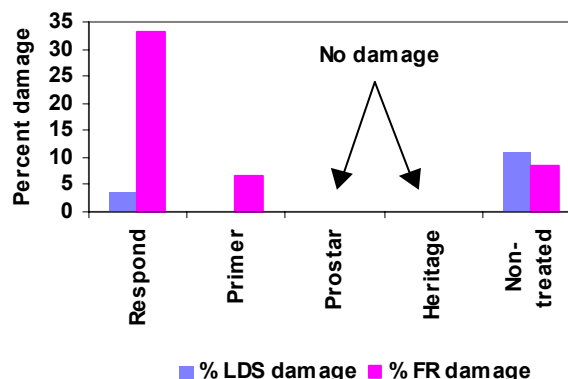
Factors contributing to the occurrence of fairy ring and dry spot

- Use of coarse textured sand (0.5 - 1-mm diameter). Drought related problems are more common here, due to the poor water holding capacity of coarser soils
- Thick thatch layers are believed to harbor the microbes that cause LDS and fairy ring
- Newer greens (6 - 18 months old) are most susceptible to LDS and fairy ring
- Creeping bentgrass, followed by Tifgreen bermudagrass are the most likely turf varieties to suffer from LDS and fairy ring
- The use of organic amendments, such as peat, appears to encourage the development of LDS and fairy ring

Fairy ring management

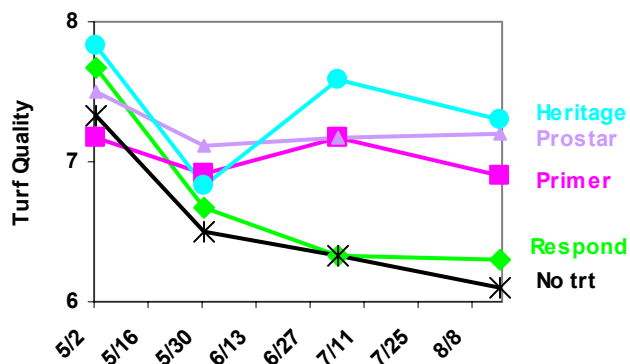
At the PACE Turfgrass Research Institute (PTRI), we have conducted research on fairy ring management since 1993. Some of our key results are illustrated in Figures 9 and 10.

Figure 9. Control of localized dry spot (LDS) and fairy ring (FR) symptoms with wetting agents and fungicides. Del Mar Country Club, David Major superintendent. 1997.



Note that in Figure 9, the fungicides Prostar and Heritage controlled both dry spot and fairy ring damage. Wetting agents (Respond and Primer) provided good control of dry spot, but did not control fairy ring damage.

Figure 10. Turf quality ratings from the same trial illustrated in Figure 9 show that control of fairy ring and dry spot symptoms with fungicides and wetting agents led to improvements in turf quality.



Based on our results and other data from the scientific literature, we have developed the following program.

- Make monthly applications of Prostar 70 WP (4.5 oz/1000 sq ft) or Heritage (0.4 oz/1000 sq ft) **when symptoms first appear**. Do not wait until soils are heavily hydrophobic and/or the disease has established itself -- control at this point is difficult, if not impossible. Discontinue applications when symptoms begin to fade.
- Consider the use of wetting agents such as Respond (UHS), Primer (Aquatrols) or a variety of others to improve fungicide performance and to alleviate dry spot symptoms (see below).
- The decision on how much post-treatment irrigation to use is a tricky one. In some locations, fairy ring fungi such as *Agrocybe* or *Bovista* grow at very shallow depths in the thatch layer, and little irrigation (a few turns on the heads at the most) or even no irrigation is sufficient for product delivery; too much irrigation may wash the fungicide below the infested areas. In other cases, the fairy ring fungi can live deeper in the root zone, and post-treatment irrigation is more important. If you are uncertain which type of fairy ring fungus is active at your site, send a sample of the fruiting bodies to a diagnostician for identification.
- maintain thatch thickness below 1/2" by regular verticutting, aerification and topdressing
- implement a spring cultivation program (based on core aerification, topdressing and deep tine aerification) to reduce compaction, break up hydrophobic soil aggregations and improve turf

health.

- Re-wet hydrophobic soils via hand watering, or through the use of equipment such as a water fork (Figure 11).

Localized dry spot and fairy ring

LDS refers to a condition caused by hydrophobic (water-repellent) soils that develop 1 - 6 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 and steep, sloping grades. To determine whether you have LDS, make sure 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.

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 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.

Figure 11. Spot treatments with equipment such as a water fork can aid in masking the symptoms of fairy ring and LDS by forcing water into the water repellent soil profile.

