# Fairy Ring Biology and Management in Turfgrass

*By Michael Fidanza, Phillip Colbaugh and Steve Davis*

Fairy ring is the name commonly given to circles of mushrooms or rapidly growing, lush green circular bands observed in established turfgrass areas (Couch, 1995).

The term "fairy ring" originated out of myth and superstition from the Middle Ages. For example, magical fairies were thought to dance within the circles of mushrooms at night. A popular myth in Holland stated that the dead grass in the ring center marked the place where the devil churned butter.

In Scotland, it was bad luck for a farmer to till the land where fairy rings were observed. In England, however, it was considered good fortune to build a house on land with fairy rings (Couch, 1995; Shantz and Pie-meisel, 1917).

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Despite the legends, fairy ring disease occurs worldwide in all cultivated turfgrasses, and is frequently observed on golf course putting greens, fairways, tees and roughs, and also general lawn areas. Fairy ring is attributed to more than 50 species of soil inhabiting, basidiomycete-type fungi (Couch, 1995; Smiley et al., 1992; Smith et al., 1989, Watschke et al., 1995; Vargas, 1994). In turfgrass ecoysystems, these basidiomycete or "mushroom" fungi primarily colonize the thatch and organic matter component in soil. In turfgrass areas, fairy ring symptoms can be expressed in many different ways.

## Fairy ring biology in turfgrass

On the surface, fairy ring symptoms can include rings or arcs of dead or unhealthy turf, rings of dark green stimulated and actively growing turf or circular patterns of mushrooms. Below the surface, the fungal mycelium often grows in a roughly circular or ring pattern through the soil, breaking down organic matter and releasing nitrogen in the form of ammonia.

As a result, soil microorganisms process the ammonia into nitrates, which is then readily available to turfgrass roots (Couch, 1995; Vargas, 1994). The conspicuous, actively growing rings of green turf are the result of this nitrogen release in the soil.

According to Couch (1995), fairy ring disease can be classified into two groups: edaphic and lectophilic. Edaphic originates from the Greek edaphos — referring to soil or earth as a foothold for higher plants, while lectophilic is composed from the Latin lectus meaning bed, litter, or thatch and the Greek philos meaning love of, or favorably disposed toward.

Edaphic fairy rings are produced by fungi that primarily colonize the soil. Lectophilic fairy rings are produced by fungi that primarily colonize the thatch and leaf litter.

Fungi that cause edaphic fairy rings can extend mycelium growth to a depth of 2 to 3 feet in the soil profile (Couch, 1995; Shantz and Piemeisel, 1917). Lectophilic fairy rings are more likely to develop on putting greens and other closely mowed, high maintenance turf (Couch, 1995; Fidanza et al., 1998; Fidanza, 1999).

Fairy rings, whether edaphic or lectophilic, can range in size from a few inches to several feet in diameter (Smiley et al.,

1992). Also, edaphic and lectophilic fairy rings are classified into three categories based on symptom expression (Couch, 1995; Fermanian et al., 1997; Shantz and Piemeisel, 1917; and Watschke et al., 1995).

Although many basidiomycete-type fungi can cause fairy ring, turfgrass researchers have identified the most common types (Couch, 1995; Fidanza, 1999; Smiley et al., 1992). In many cases, edaphic fairy rings are attributed to:

* Marasmius,
* Chlorophyllum,
* Lepiota (this fungus produces the "really big" mushrooms), and
* Agaricus spp. (referred to as the "meadow mushroom").

Recently, many cases of lectophilic fairy ring have been attributed to Lycoperdon spp. (referred to as the "puff-ball" mushroom) (Couch, 2000; Fidanza et al., 1998; Fidanza, 1999).

Fairy ring, either edaphic or lectophilic, has also been caused by the following:

* Scleroderma,
* Tricholoma,
* Clitocybe,
* Agrocybe,
* Bovista (similar to Lycoperdon),
* Coprinus ("mica cap" mushroom),
* Panaeolina ("haymaker's" mushroom — common on home lawns),
* Coprinus ("shaggy mane" or "inky cap" mushroom), and
* Conocybe spp. ("dunce cap" mushroom),
* and more (Barron and Hsiang, 1999; Fidanza, 1999).

## Appearances in 1999

Turfgrass injury symptoms and damage due to fairy ring typically occur during periods of hot, dry and drought-like environmental conditions.

For example, in Florida it is common to observe fairy ring symptoms during the prolonged dry, low rainfall period of late winter through early spring. In many other parts of the United States, fairy ring symptoms are observed during the hot, dry summer months and sometimes into the fall.

During dry periods, mushrooms will often appear within a day after a heavy rain (Watschke et al., 1995). Recently, fairy ring has become an increasing problem on golf courses throughout the country.

Increased fairy ring symptoms have been observed in New England this past fall following the hot, dry summer. Fairy rings in this region are caused primarily by Marasmius, but Agaricus and Lycoperdon spp. are also prevalent.

The Northeast and mid-Atlantic regions experienced one of the worst years for fairy ring problems on greens and fairways. Fairy ring is more noticeable and therefore more serious on greens due to surface quality expectations. In these regions, fairy rings are attributed to Marasmius, Chlorophyllum and Lycoperdon spp.

In the South and Southeast, Lycoperdon spp. has become increasingly problematic on greens, while Marasmius, Chlorophyllum and Agaricus spp. are also observed on golf course turf.

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Due to an increase in the construction and use of sand-based greens coupled with the trend toward low fertility, low cutting height, demand for increased green speed and intense maintenance to those greens, an increase in lectophilic fairy ring caused by Lycoperdon spp. has been observed.

In Florida, lectophilic fairy ring symptoms from Lyco-perdon spp. are commonly observed on new or rebuilt ber-muda-grass greens within one year after sprigging.

In the upper Midwest, severe "killing rings" (lectophilic —Type C) have been observed on "push-up" greens and newly built, sand-based USGA greens after about one year. Throughout the Midwest, fairy rings are attributed to Marasmius, Chlorophyllum and Agaricus spp.

Edaphic fairy rings in the Northwest caused by Marasmius spp. are commonly observed on greens, fairways, parks and lawns from spring to early fall. In the Southwest, fairy ring is frequently attributed to Agrocybe and Bovista spp. (similar to Lycoperdon spp.).

## How do fairy rings kill turf?

Turf pathologists currently agree that the fungal mycelium in the soil can accumulate in large amounts and also will coat sand and soil particles, which results in a soil profile that is hydrophobic or "water-repelling." The result is a soil profile that is hydrophobic or water repellent.

Therefore, the turfgrass plants are injured or killed due to competition for water and nutrients. Once the soil profile or thatch (which is colonized by the fungal mycelium) becomes dry or hydrophobic, it is difficult to re-wet.

In summary, previous research reveals that fairy ring fungi can injure or kill turfgrass from a complex combination of the development of hydrophobic soil conditions, release of compounds toxic to turfgrass roots and the depletion of available nitrogen for plant growth (Couch, 1995; Watschke et al., 1995).

## Management options in turfgrass

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The decision regarding a management strategy depends on whether the actual fungus is edaphic (soil inhabiting) or lectophilic (thatch inhabiting), the level of turf maintenance (i.e., putting green, fairway or home lawn) and the degree to which the symptoms are expressed.

Also, by knowing the environmental conditions or time of year most favorable for the appearance of fairy ring symptoms, turf managers can plan ahead to manage the symptoms, control the fairy ring fungus and maintain healthy turf.

**Preventive option.** Here is an example of a preventive approach. This example of a preventive strategy began at Sun 'N Lake Golf Club in Sebring, FL (Fidanza et al., 1998). The golf course had rebuilt nine putting greens during the spring of 1995, however, severe turf injury symptoms due to lectophilic fairy ring were observed during the following spring.

Prior to reconstructing the nine remaining greens, the club wanted to prevent fairy ring from again becoming a serious problem. Club officials consulted with Dr. Monica Elliott of the University of Florida to develop a preventive solution.

The nine additional greens were rebuilt during the spring of 1996 in the same manner as before, namely by using a sand-based, modified USGA specification plan. The nine, newly rebuilt greens were sprigged in May 1996 with "Tifdwarf" bermudagrass. In November 1996, the greens were overseeded with "Gator" perennial ryegrass.

For this field study, the nine reconstructed greens were split, with one-half receiving a treatment program of ProStar (50WP fungicide plus Primer soil wetting agent — 3 oz. + 6 fl. oz. per 1000 sq. ft.), and the second half was left as an untreated check for comparison.

At the time of this study, ProStar 50WP was the only fungicide labeled for fairy ring control. Also, a soil wetting agent was included to help alleviate the hydrophobic soil conditions.

The fungicide/soil wetting agent tank-mix was first applied in September 1996 and continued at six-week intervals through January 1997 for a total of four preventive applications.

By March 1997, necrotic injury symptoms attributed to lectophilic fairy ring (identified as Lycoperdon spp.) began to appear on the untreated half of each green. The appearance of fairy ring corresponded to the typical dry, drought-like environmental conditions common in Florida at that time of the year.

An average of 23 rings were observed on the untreated half of each green. The majority of the rings ranged from <1 to 2 feet in diameter.

The overall quality in the untreated half of each green was considered unacceptable by the superintendent. No necrotic rings or fairy ring symptoms, however, were observed on the treated half of each green.

Due to the severe turf injury on the untreated half of each green, a curative application of ProStar 50WP plus Primer (6 oz. + 6 fl. oz. per 1000 sq. ft.) was delivered to the untreated half of each green in March 1997.

By May 1997, no necrotic rings or turf injury was visible in those previously untreated halves, and the bermudagrass had recovered and filled into the previously damaged areas.

**Curative option.** Here are alternative strategies to consider. For lectophilic fairy rings on greens, success has been observed with the use of a combination approach of a fungicide plus soil wetting agent. Couch (1999, 2000) has outlined an integrated approach of fungicide, soil wetting agent, irrigation and cultural practices to manage fairy ring in turf.

The wetting agent helps to alleviate the hydrophobic soil condition, thereby allowing water to move more easily through the thatch and soil profile, and the irrigation helps the fungicide penetrate and reach the fungus.

In some Southern California cases, heavy irrigation following a fungicide application seemed to "push" the material through the sand profile away from the lectophilic fungal mycelium in the thatch (Fidanza, 1999).

Research at Texas A & M has shown the positive benefits of subsurface injection equipment to control fairy ring (Colbaugh, 1999). This provides better placement of a control agent into the thatch and soil profile, thus reaching the fairy ring fungus with no adverse effects to the desired turf.

Although not always practical on golf course turf, fairy ring can also be managed through suppression and by destructive methods. Symptoms can be suppressed through the use of cultural practices such as aerification, core cultivation, deep watering and the use of surfactants to thoroughly wet the soil profile plus fertilization to promote healthy turf and therefore mask the symptoms (Couch, 2000; Watschke et al., 1995). Fairy ring symptoms may be temporarily alleviated but the fairy ring-causing fungus is still viable in the thatch or soil.

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Destructive methods are another way to control fairy ring (Watschke et al., 1995). These methods may be costly, labor intensive, unsuccessful and not always practical for most golf courses. One example is to remove the turf in the area affected by fairy ring, till and mix the underlying soil in several directions, then reseed or sod the area. By mixing the soil, this will promote the natural antagonism that occurs among fairy ring mycelium in the soil. Fairy rings have been known to dissipate when they contact each other due to their antagonistic nature.

Curative research efforts are underway. Research on fairy ring management includes the evaluation of fungicides, various soil wetting products and types and cultural practices (Colbaugh, 1999; Couch, 1999; Fidanza, 1999). The goal is to develop strategies aimed at maintaining healthy turf, reducing hydrophobic soil conditions attributed to the fairy ring fungi and controlling the fungus.

At Texas A& M University, research is also focused on understanding the biology and pathogenic nature of these fungi that cause fairy ring in turf. Preliminary results show that some types of fairy ring fungi can inhibit creeping bentgrass growth and development, while other types have no influence.

You can help with this research! Please forward samples of actual mushrooms, or photos of fairy ring mushrooms and turf symptoms, to the following:

Fairy Ring Characterization Project
Attention: Dr. Phillip Colbaugh
Texas A & M University
17360 Coit Road
Dallas, TX 75252

If you are sending a mushroom, wrap the sample in a dry paper towel and ship overnight. Along with the actual mushroom sample or photo, be sure to include relevant information such as state, location on golf course, turfgrass variety and environmental conditions.

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