Derek Settle Ph.D. *Chicago District Golf Association,* and
Michael Fidanza Ph.D. *Pennsylvania State University*

Fairy Ring Research

*Dr. Mike Fidanza of Penn-State University has been leading the pack on investigations of fairy ring by plant pathologists. He has been conducting on-site evaluations for many years on how to suppress fairy ring on golf courses with fungicides. Of his investigations, he has written numerous popular articles (*Fidanza, M. 2007. New Insight on Fairy Ring. Golf Course Management 75 (3):133-136*), as well as scientific publications (*Fidanza, M. A. et al. 2005. Use of high-pressure injection to alleviate Type-I fairy ring symptoms in turfgrass. HortTechnology 15:169-172*).*

Figure 1.
Lycoperdon *spp. Puffball emerging on a green at Sunshine Golf Course, Lemont, IL. Photo D. Settle taken 5 July, 2006*

Figure 2.
An example of a mushroom of a basidiomycete fungus, Lemont, IL. Photo D. Settle taken 21 August, 2006

In replicated field trials during 2005, Dr. Fidanza and Dr. Jack Fry of Kansas State University found that the combination of a wetting agent and a fungicide improved control of fairy ring versus a fungicide alone. During the summer of 2006, the CDGA studied fairy ring in collaboration with both researchers. The CDGA study occurred on a practice putting green at Twin Orchard Country Club in Long Grove, Illinois. In July 2005, this putting green exhibited an abundance of fairy ring that was well distributed throughout and as it turned out made an ideal test plot.

Background

Fairy ring is a term that dates to Europe's Medieval Period (500 to 1500 AD). The first time I saw fairy ring was in a Kansas farmer's brome field that was maintained and baled as hay for horses. We viewed a large, green, twelve-foot ring from our vantage point atop horses. With a broad smile, the farmer explained how the night before, fairies had danced in a circle creating the ring. Sometimes, he added the ring was edged by large white mushrooms. At the time, I remember wondering if I would ever hear that story again. Fast-forward twenty years and the disorder, its name and its story has appeared again in my life as a turfgrass pathologist.

Several soil-borne *basidiomycete* fungi are responsible for fairy ring. Often after a thunderstorm, the fungi produce above ground fruiting structures. These structures produce spores that are windborne and are responsible for the reproduction of the fungi. Their varied color, shape, and size tell a story of diversity with two *basidiocarps* common – puffballs (**Figure 1**) or mushrooms (**Figure 2**). Symptoms of the multiple causal fungi are grouped into 3 Types. Using the numbered types from one to three turfgrass pathologists describe fairy ring.

Type I = dead rings,
Type II = green rings,
Type III = rings of mushrooms/puffballs.

Individual rings can have a combination of the symptoms with Type I dead rings (**Figure 3**) or Type II green rings (**Figure 4**) Type III fruiting structures (mushrooms or puffballs) may be present as well.

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Figure 3.
An example of Type I fairy ring (dead rings) on a green in Chicago. Photo D. Settle taken 31 July, 2006

Figure 4.
An example of a Type II fairy ring (green rings) on a practice putting green, Long Grove, IL. Photo D. Settle taken 10 August, 2006

In Chicago, fairy ring is an increasing concern for golf course superintendents. The disease is difficult to predict and often more difficult to control. The disease usually peaks midsummer on sand-based putting greens when recuperative potential of cool-season turf is low. Because this disease is caused by multiple soilborne fungi, preventive control with a labeled fungicide is not always guaranteed. The lack of control or ineffectiveness of a fungicide occurs because even distribution of fungicides in the soil is generally difficult to achieve. Excessive thatch can complicate this process as well. Current recommendations to target fairy ring belie the fact that its activity is belowground. Applications are accomplished using high-carrier spray volumes or are immediately "watered in" with irrigation systems in order to move the fungicide into the soil profile.

Recently, wetting agents / soil surfactants have gained acceptance as an additional strategy to help suppress fairy ring. In 2005, two coast to coast studies (Dr. Frank Wong in California and Dr. Bruce Martin in South Carolina) found a tank-mix combination of fungicide with a soil surfactant improved the treatment's efficacy to reduce symptoms on creeping bentgrass putting greens. Both replicated studies used RevolutionTM, but other wetting agents/soil surfactants may produce similar results. For example, Dr. Fidanza reported TriCureTM suppressed fairy ring symptoms on a perennial ryegrass fairway in a Pennsylvania study during 2005. A recent review of wetting agent choices exists (*Karnok, K. J. 2006. Which wetting agent is best? Golf Course Management 74(7):82-83*).

Results of Summer 2006

Dr. Fidanza was successful on a perennial ryegrass fairway at a golf course in Gladwyne, Pennsylvania, as was the CDGA on a bentgrass/annual bluegrass green in Long Grove, Illinois. These studies are important because many fungicides are currently labeled to control fairy ring (**Table 1**), but replicated data comparing their efficacy in the field remains sparse. The study conducted at Kansas State during 2006 did not yield any conclusive results. One reason may be the unpredictability of a disease like fairy ring.

Study One Results Gladwyne, PA

The treatments used in the California study were repeated in 2006 on a perennial ryegrass fairway on a golf course in Southeastern Pennsylvania. The same treatments, application rates, and water carrier volumes were applied through flat-fan nozzles on 25 May and 20 June 2006 for curative control of Type I and II fairy ring symptoms (**Figure 5**). Treatments were arranged in a randomized complete block design with three replications, and plots measured 3 x 5 ft. Results from 24 June 2006 reveal a trend of better fairy ring control with fungicides alone delivered at the higher water volume when compared to fungicides alone at the lower water volume. Also, any of the fungicides tested tank-mixed with RevolutionTM provided better fairy ring control versus fungicides alone at either water carrier volume (**Figure 5**).

Fairy ring control with fungicides and soil surfactants may require patience. For example, a creeping

Table 1.
List of fungicides currently labeled for treatment of fairy ring disease in turf.

Active Ingredient	Trade Name and Formulation	Manufacturer[1]	Remarks[2]
azoxystrobin	Heritiage 50WG	Syngenta	0.4 oz, 28-day interval, 4 gal water/1000 sq ft
azoxystrobin	Heritage TL	Syngenta	2 fl oz, 28-day interval, 4 gal water/1000 sq ft
azoxystrobin + propiconazole	Headway 1.39EC	Syngenta	3 fl oz, 28-day interval , 4 gal water/1000 sq ft
flutolanil	Prostar 70WP	Bayer	preventive: 2.2 oz, 21-28 day interval curative: 4.5 oz, 30 day interval
polyoxin-D	Endorse 2.5WP	Cleary	4 oz, 2–3 apps, 7-day int., min. 2 gal water/1000 sq ft, include soil surfactant, irrigate 0.05 to 0.1 inch
pyraclostrobin	Insignia 20WG	BASF	0.9 oz, 28-day interval
triadimefon	Bayleton 50WP	Bayer	1-2 oz, 14-day interval, 2 oz, 21-day int. (*Poa* greens), 2(ee) preventive use: AR, CA, CO, GA, IA, ID, IL, IN, KS, MI, MN, MO, NE, NC, OH, OK, OR, PA, TN, VA, WI (pending approval in: DE, CT, DE, HI, KY, MA, MD, ME, NH, NJ, NY, RI, VT, WV)

[1]BASF, Research Triangle Park, NC; Bayer Environmental Science, Research Triangle Park, NC; Cleary Chemical Company, Dayton, NJ; Syngenta Professional Products, Greensboro, NC.
[2]Product rate/1000 sq ft, application interval, and water carrier volume/1000 sq ft as listed on the product labels. Refer to product labels for specific information and instructions for product use.

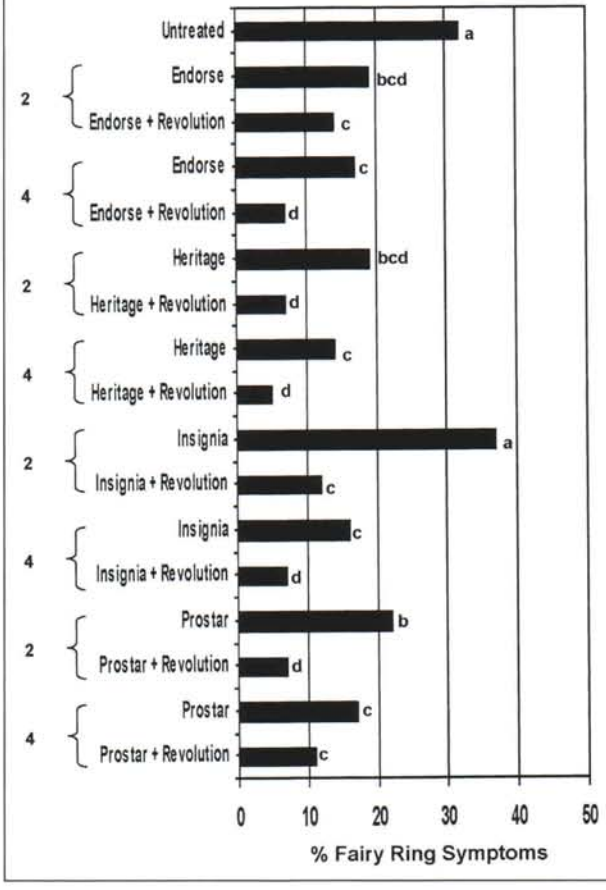

Figure 5. Percent fairy ring symptoms (Type-I and II) on a perennial ryegrass fairway evaluated 24 July 2006, Pennsylvania. Fungicide treatments/1000 sq ft were: Endorse 2.5WP (4 oz), Heritage 50WG (0.4 oz), Insignia 20WG (0.9 oz), and ProStar 70WP (4.5 oz); and Revolution soil surfactant (6 fl oz). Treatments were applied in 2 or 4 gal water carrier per 1000 sq ft on 25 May and 20 June 2006. Means followed by the same letter are not statistically different according to Fisher's protected least significant difference test ($P < 0.05$).

bentgrass fairway in Pennsylvania was treated for curative control of Type-II fairy ring. The rings were large enough so that each individual ring was equally divided into four quadrants, with each quadrant about three feet wide. Therefore, each ring received four treatments, one treatment placed across the ring in each quadrant: ProStar® alone (4.5 oz/1000 sq ft), RevolutionTM alone (6 fl oz/1000 sq ft), ProStar + RevolutionTM (4.5 oz + 6 fl oz/1000 sq ft), and an untreated check. A total of three rings were used for this field test. All treatments were applied from flat-fan nozzles in 4 gal water carrier/1000 sq ft, followed by 0.1 inch overhead irrigation. All treatments were applied July 1 and again July 30, 2003. The Type-II fairy ring symptoms persisted through July and August, but all rings "dissipated" or those symptoms were "masked" by September in conjunction with a fairway fertilizer application. So, none of the treatments appeared to work in 2003. In 2004, however, Type-II symptoms reappeared again by mid-July with a peculiar "disruption" in each of the rings. Only the section of the ring treated with the ProStar® + RevolutionTM tank-mix was symptom-free. By knowing where and when fairy ring occurs may help plan for a preventive as well as curative control program.

In practice, and if time, resources, and turf conditions allow, aerate (i.e., "needle tines") the fairy ring-affected area first, then treat with a fungicide/soil surfactant program with enough water carrier and supplemental irrigation to "move" the treatment into the thatch and rootzone. However, in primarily sand-based sites, excessive amounts of water could "push" the treatment past the intended target area. Currently, a combination of cultural practices, fungicides now labeled for fairy ring, and soil surfactants is the best approach to combating fairy ring.

Study Two Results Long Grove, IL

The treatments used in the 2005 Kansas study were repeated in 2006 on a bentgrass/annual bluegrass green in Chicago. Application

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rates and water carrier volumes (2 gal per 1000 sq ft) were applied through flat-fan nozzles of a CO^2-powered backpack sprayer for preventive control of Type-II fairy ring symptoms. Preventive rates were applied three times approximately every 28 days on 6 June, 27 June, and 31 July. The fungicide rates (per 1,000 sq ft) included; Bayleton® at 2 oz, ProStar® at 4.5 oz, HeadwayTM at 3 fl oz, Heritage® TL at 2 fl oz, Banner MaxxTM at 2 fl oz, and Insignia® at 0.9 oz.

All fungicides were applied with or without RevolutionTM at 6 fl oz/1000 sq ft. Whenever RevolutionTM was applied it was immediately watered in, whereas fungicides applied alone were not. Treatments were arranged in a randomized complete block design with four replications, and plots measured 4 x 6 ft. Data was taken on two dates each summer month and included; fairy ring percent plot damage, visual ring intensity, and visual turfgrass quality. Peak Type II fairy ring developed midsummer on 31 July and 10 August when approximately 16% plot damage existed in untreated plots (**Figure 6**). Treatments were compared using Fisher's LSD test.

Surprisingly, fungicides suppressed percent fairy ring per plot only on one date, 31 July. This underscores the difficulty that superintendents can face when addressing an outbreak of fairy ring on greens using preventive timing and the best available products/strategies. Overall, we found multiple fungicides alone and not watered can reduce fairy ring by at least 50% (**Figure 7**). The addition of RevolutionTM with fungicides and watered-in did not improve fungicide efficacy as we had expected at midsummer. However, RevolutionTM alone or mixed with fungicides did speed plot recovery of the green using visual ring intensity data (1 to 4 scale, with 4 = highly visible rings). On that date, 28 August, 5% of plot damage still existed in untreated plots and the addition of RevolutionTM reduced fairy ring symptom intensity across all treatments by 37% ($P < 0.01$). Based on Dr. Findanza's research and others, wetting agents/soil surfactants commonly aid the suppression of fairy

Figure 6.
Symptoms of Type II fairy ring within fungicide test plots on a practice putting green, Long grove, IL. Photo D. Settle taken 10 August, 2006

ring symptoms. However, their overall effect can be erratic, similar to the use of fungicides alone. It is likely that wetting agents are most useful during dry years such as occurred the summer of 2005 in the Midwest. Chicago was very wet in 2006, and this may have negated the positive effects by RevolutionTM.

Finally, visual quality ratings of treatments to address fairy ring on Twin Orchard's putting green yielded good information. Those ratings indicated all demethylase inhibitors (DMIs) in this study (Bayleton®, Banner MaxxTM and HeadwayTM) are somewhat phytotoxic at midsummer. At warmer temperatures, DMI fungicides can cause bronzing or thinning turfgrass at green height due to their growth regulator effect. Based on this study,

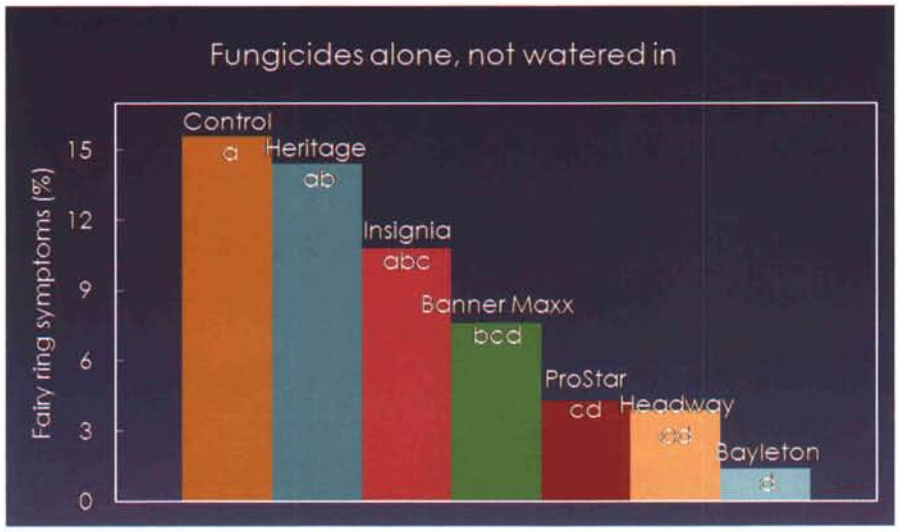

Figure 7.
Percent fairy ring symptoms (Type II) on a bentgrass/annual bluegrass green evaluated 31 July, Illinois. Treatments presented were applied in 2 gal water carrier per 1000 sq ft and not watered in. Revolution treatments are not shown. Means followed by the same letter are not statistically different according to Fisher's protected least significant difference test ($P < 0.05$).

Bayleton® consistently showed a trend of very good fairy ring suppression as did ProStar®. From July on, ProStar® (anilide or carboxamide fungicide group) should be used to address fairy ring curatively because it does not risk phytotoxicity at summer. Of all cultural practices, fertility is most important for fairy ring and conditions of low nitrogen will exacerbate fairy ring symptoms. During a fairy ring outbreak, moderately increase N on greens whenever possible. In the end, superintendents may need to try several methods before finding a control/suppression strategy that will work best on individual greens that are negatively impacted by fairy ring at summer.

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