Figure 2. Characteristic symptoms of roots and crowns suffering from take-all patch.

Conditions that favor take-all patch development are fumigated soils planted with creeping bentgrass. Take-all patch is also favored by lighter textured soils, manganese fertility and pH's above 6.5. When thinking about pH, the goal is not to reduce bulk pH rather to influence pH around the rhizosphere (area under the influence of the root). Thus the use of ammonium sulfate may limit take-all patch development, but may not impact the bulk soil pH. Manganese fertility was shown to limit take-all development, yet this work was done in New Jersey on a site with pH > 6.2 and with very low manganese concentrations. However, applications of manganese in April or May at 2 lbs Mn/acre may reduce, not eliminate, take-all patch severity.

Fungicides maybe the only recourse for turfgrass managers struggling with take-all patch and there are a number of products that work. Fungicides with the QoIs (Heritage, Insignia, Disarm) and DMIs (Triton FLO, Tourney, Trinity, Torque, Bayleton, Eagle) have all been shown to have some level of efficacy against take-all patch. Applications of fungicides should be conducted when soil temperatures consistently (3 to 5 days in a row) reach 55oF. A follow-up application 21 to 28 days later is suggested as long as soil temperatures have not exceeded 65oF. Keep in mind that the take-all patch fungus lives below the soil surface, so it is imperative to get the fungicides in contact with the pathogen. Watering the product in immediately after application or applying the products in 4 to 5 gal/1000ft2 can accomplish this.

The beauty of take-all patch is the severity of the disease decreases over time. The theory behind this is as the microbial populations grow and shift overtime they become antagonistic towards the take-all patch fungus. This has never been officially documented in turfgrass systems, but many have observed this phenomenon. Depending on the age of your course and the tolerance of your clientele, take-all patch applications may actually not be needed. The beauty of take-all patch control is the application timings and products coincide very well with preventative fairy ring applications.

Summer patch

Summer patch is caused by the fungus Magnaporthe poae, which can infect annual bluegrass, Kentucky bluegrass, fine fescue and to some extent creeping bentgrass. Symptoms typically appear in mid to late summer as circular patches of yellow to orange turf (Figure 3). In mixed stands of annual bluegrass and creeping bentgrass the annual bluegrass will be the primary species affected. In taller cut turf such as Kentucky bluegrass and fine fescues, the symptoms are circular, straw colored, depressed areas ranging from 3 to 12 inches in diameter (Figure 4). Affected roots, rhizomes and crowns have a dark brown appearance.

Infection of roots starts in late spring when soil temperatures stabilize around 65 to 70oF and colonization of the below ground tissue continues until soil temperatures reach 95oF. The summer patch fungus's competitive advantage is it has the ability to grow at high soil temperatures with relatively little soil moisture. Basically the summer patch fungus acts very similar to Gga except that it begins the infection process a bit later in the season.

Figure 3. Stand symptoms of summer patch on an annual bluegrass putting green. Note that creeping bentgrass is surviving in the centers of the patches. (Courtesy of P.H. Dernoeden)

Control of summer patch can be achieved by integrated cultural and chemical means. If summer patch has been a problem, then it is likely that there are issues with drainage and compaction at the site.

Figure 4. Severe summer patch of red fescue, note the orange color with depressed patches. (Courtesy P.H. Dernoeden)

Aerification in the spring and fall is an excellent cultural control method for summer patch. Since summer patch is associated with summer stress, another option is to alternate mowing and rolling. This will alleviate stress on the annual bluegrass plants and protect the limited root systems during the summer months.

Like take-all patch, chemical control methods are typically warranted for summer patch. Largely because of the unpredictability of this disease and that once symptoms develop there is nothing that can be done. Preventative applications for summer patch should be performed when soil temperatures are consistently between 65 and 68oF. Products that work well are the QoI (see above for products), DMI (see above) and benzimidazole (thiophanate methyl). These products should be applied in high volumes of water (4 to 5 gal/1000ft2) or irrigated in with 1/8 inch of water. Summer patch can be suppressed once symptoms develop, but only to a limited degree.

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Endocrine Disruption and Turfgrass Pesticides

By Paul Koch, Turfgrass Diagnostic Lab Manager &
By Dr. Jim Kerns, Department of Pathology, University of Wisconsin -Madison

Most people don't know who Philippus Aureolus Theophrastus Bombastus von Hohenheim is, but his work and theories in the early 16th century has had a profound effect on how pesticides are regulated around the world today. Better known as Paracelsus, this Swiss biologist is often referred to as the father of toxicology. In general terms he is probably most famous for naming the metal zinc, but in the world of toxicology he is most famous for developing the phrase "the dose makes the poison." In other words, Paracelsus realized from his experiments that basically anything could be toxic when presented in large doses. On the other hand, basically anything could be non-toxic if exposure was sufficiently small.

There was no doubt that some substances were more toxic than others and needed to be contained to prevent toxicity, but the underlying theory that anything can be toxic in the proper dose was a critical thought process and still holds today. The Environmental Protection Agency (EPA), and similar agencies around the world, still regulate pesticides based on this theory today. The Food Quality Protection Act (FQPA) of 1996 mandated that chemicals be regulated based on their total exposure in the environment, the so-called "risk cup." This meant that even highly toxic chemicals still could be present in the environment and in food if kept below levels established generally through animal testing. But those "acute" toxicity levels are generally developed by how much of the pesticide causes 50% of the animal population to die. As both the knowledge of and the concern over pesticides in the environment has increased, it's clear that much more than the death of an organism is important in determining pesticide toxicity.

One non-acute effect of pesticides and other toxins in the environment that has been garnering increased attention in recent years is the activity of endocrine disruptors. Much of this increased attention can be attributed to the ongoing regulatory battle of bisphenol A (BPA), a common compound used in many plastics. BPA, like other endocrine disruptors, has been implicated as a factor in breast cancer, prostate cancer, and other reproductive disorders. Endocrine disruption is a general term for any substance that may interfere with the endocrine system, which includes many hormones secreted by the hypothalamus, pituitary gland, thryroid gland, and gonads. The key difference between endocrine disruptors and other forms of pesticide toxicity is the extraordinarily low concentrations at which the endocrine system can be disrupted. This has altered long-held beliefs about the dangers of environmental compounds present in very low concentrations, and shows that Paracelsus' theory may not be relevant when it comes to endocrine disrupting chemicals.

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Endocrine disruption (ED) is difficult to determine in nature or humans for two main reasons. One, as previously discussed, ED can be initiated at very low toxin concentration. Two, because some ED agents act during reproduction it can take years or generations to see the effects (Mendes, 2002). In fact, much of the early endocrine disruption observations occurred in amphibious organisms that had altered sex characteristics and reproductive disorders. It wasn't until decades later, and the book Our Stolen Future by Theo Colburn in 1996, that the potential effects of EDs were recognized on a large scale. The widespread nature of ED agents in the environment coupled with the increasing rates of breast cancer, prostate cancer, testicular cancer, and decreasing sperm counts present in the male population led many to look for a potential connection (Mendes, 2002).

How does endocrine disruption affect the current array of turfgrass pesticides? The current answer is not at all, but that will likely change. In 1994 the National Academy of Science formed the Endocrine Modulators Panel. A little-known provision in the 1996 FQPA required that pesticides be screened for estrogenic effects that may alter the endocrine system, BUT that appropriate tests be used in the analysis. The use of appropriate tests is where the system has really bogged down. In 1996 the Endocrine Disruptors Screening and Testing Advisory Committee (EDSTAC) was formed, and released its final report for testing in 1998. In 2001, an Endocrine Disruptor Methods Validation Subcommittee (EDMVS) was formed to further develop quality screening assays that could determine the endocrine disrupting effects of environmental chemicals. These committees formed two "tiers" of screening assay designed to determine the endocrine disrupting effects of chemicals accurately and efficiently. Tier I assays are a series of assays that are meant to test short-term effects quickly and cheaply. Examples include how tightly the pesticide molecules bind to different endocrine molecules in the lab, and how they affect the organ development in certain animals. Critics of the Tier I assays say they are prohibitively expensive, and that binding to endocrine molecules in the lab may mean nothing in nature. Tier II assays are meant to test reproductive effects and are generally done in rat, fish, or frog experiments. Critics of these assays cite the even higher costs of the Tier II assays and the wide range of effects that alter reproduction in these animal systems.

Despite these criticisms and delays, routine screening by the EPA for endocrine disruption appears to be progressing. Ten years following the formation of the committee to develop the endocrine disruption screening, an initial list of chemicals for endocrine screening was released on April 15th, 2009. Nineteen months later, in November of 2010, an additional list of chemicals to be tested was released by the EPA. A number of turfgrass pesticides are present on these two lists and will be tested for their ED effects in the coming weeks, months, and years (Table 1). It is important to note, though, that inclusion on this list is simply by means of potential exposure to the public and other at-risk groups and is not meant to suggest any endocrine disruption activity. Chlrothalonil, for example, is on this list but has shown little to no signs of ED activity in university assays (Andersen et al., 2002). Iprodione and vinclozolin, on the other hand, are also on this list and have been implicated in several university studies as ED agents (Blystone et al., 2007; Ferraris et al., 2005).

More information on the endocrine disrupting effects become available it is likely that as an applicator of pesticides you may be asked by members of your club or members of the public to provide more information about the products you apply. An in depth knowledge of the subject is unnecessary and likely impossible unless your employer has the money to send you to medical school. Recognition of the term endocrine disruptor, a basic knowledge of the effects that ED agents may cause, and a listing of any products in your chemical shed that have been implicated as ED agents will go a long way towards the perception of turfgrass managers as responsible stewards of the environment. For more information on the EPA's endocrine disruptor screening program, including the full list of chemicals to be screened, visit www.epa.gov/endo.

O.J. Noer Turfgrass
Research
and Education Facility
2502 County Highway M
Verona, WI 53593

Phone: (608) 845-2535
Fax: (608) 845-8162
Email: plkoch@wisc.edu
Website:http://tdl.wisc.edu

Initial List on April 15, 2009	Additional List on Nov 17, 2010
2,4-d	Fosetyl-AI
Captan	Fenarimol
Carbaryl	Paclobutrazol
Chlorothalonil	Thiophanate-methyl
Flutolonil	Trinexapac-ethyl
Iprodione	Vinclozolin
Metalaxyl	
Myclobutanil	
Propiconazole	
Tebuconazole	
Triadimefon	

Table 1. A list of the chemicals of potential interest to the turfgrass industry that are included in the final list to be screened for Tier I endocrine disrupting activity. Inclusion on this list is based solely on potential exposure to the public and at-risk populations and does not imply endocrine disrupting activity.

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Par 7

By Jake Schneider, Assistant Superintendent, Blackhawk Country Club

From what I've been told, golf is supposed to be fun, and during approximately 15% of the 30ish annual rounds that I play, I would have to agree with the statement. During the other 85% of the time, my time is spent sulking over a wayward drive, a chunky approach shot, or, worse yet, surrendering 50 cents to a playing partner who didn't succumb to the same maladies. Yes, we play for some pretty high stakes, and no, I won't give you that one-foot putt that's for double bogey. If you read my last column, you hopefully have a better understanding for the pain that is associated with money leaving my possession. Regardless, our Monday golf outings are a highlight of the week, which means that I'm either a sucker for torture or that I might actually enjoy the silly, little game more than I care to admit.

Despite completely lacking any form of leverage due to my less-than-imposing stature, I'm able to put a pretty good charge into my shots, and I at least have potential to par every hole. More often than not, this potential goes unrealized, but that's already been established. Eventually, the time will come that my Mr. Universe-esque physique will diminish and my bag will be filled with 13 woods and a putter. When that time comes, 200-yard drives will cause for celebration. The fact of the matter is that there are a lot golfers, and more importantly, potential golfers, out there who fall into this same category.

At this year's Golf Industry Show in Orlando, Judy Rankin, the 2010 Old Tom Morris Award winner, gave a tremendous talk, and at one point, she suggested that making par a reasonable number is one way to grow the game. In other words, if the vast majority of the players who use the forward tee on a 500-yard par five have absolutely no chance of achieving par, why can't this hole play as a par seven from that tee? Quite frankly, despite the handicapping system, people like to get a true bogey or better; it sounds and feels better (in my completely unprofessional opinion). As a 15 handicap, I only like those score reductions when it results in a positive cash flow. Even then, it still kind of feels like cheating, but not to the extent that any refunds are offered.

And, while this whole "par seven" proposal may be a little far-fetched, unreasonable, and void of most major details, it's no secret that we, as greenkeepers, must do our best to help grow the game. Having reasonable pins, tee blocks set forward, and peripheries that don't swallow errant shots and result in 15-minute search parties are some of the standard ways to keep players moving and to make the game enjoyable for the average Joe and Jane.

Now, the challenge is to come up with innovative solutions and practices that will get more people interested in this great (and frustrating game). Within the past couple of years, junior tees were established on all 18 holes at Blackhawk. These "tees" are nothing more than metal disks that are located in the fairways, but they give a much more official feel for our future paying golfers. Innovative, may be not (I leave innovation to the Judy Rankin's of the world), but it's a simple touch that makes the holes much more reasonable for our youngest members. It makes sense to me that we should do as much as possible for those that fill the cash registers. However, getting worked up over losing paltry sums of money during mostly free golf rounds also makes sense in my disproportionately large melon, so take it with a grain of salt. Regardless, let's hope that 2011 is a year filled with growth and not just for turf.

Have the Noer Facility in Your Backyard

By Bill Kreuser, Graduate Student Cornell University

Editors Note: Bill Kreuser received his Bachelors and Masters Degrees from University of Wisconsin Madison. He is now working on his Doctorate with Dr. Frank Rossi at Cornell University.

As some of you know, I got my start in the turfgrass industry when I was fifteen years old. That summer I got a job busing tables at Saz's restaurant during the Wisconsin State Fair. Instead of blowing the money on typical teenage 'necessities', I spent the $500 paycheck on tons of sand, pea gravel, and 4 inch plastic drain tile. The goal was simple, build a USGA spec putting green in my parent's backyard partly because so many told me it couldn't be done.

Over the course of the next three summers my 'A4' putting green project expanded into a chipping course complete with a meandering bentgrass fairway and five sand bunkers. When I look back at it now I realize how much I learned in that backyard. It provided me a turfgrass research facility where I could experiment with different management techniques, products, and ideas without fear of killing grass; a frequent occurrence. In fact, the Primo Maxx GDD studies of my B.S. and M.S. at UW-Madison came directly from questions and ideas I had while working on my backyard putting green.

The goal of this article is not to introduce a new management technique or product but is to explain how to do turfgrass field research in your own backyard (or at your golf course). It can be extremely advantageous to have some kind of research area at your golf course. It provides you the opportunity to test the effectiveness of new products, compatibility between products, evaluate new grass varieties, test different irrigation regimes, and try new equipment or different settings (i.e. mowing heights or aerator tine diameter and spacing).

The research area can also be used to demonstrate a particular management practice to your superiors, green committee, or membership. It can also be a great teaching tool for summer interns or assistant superintendents. In any case a small turfgrass research area can be a great benefit to you and your facility. In this article I'll discuss how to design a basic experiment, set up research plots, and collect and analyze data in a cheap, easy, and hopefully understandable fashion. Even if you have absolutely no intention of doing any research, I hope this article helps you to understand what goes into field research and understand research reports.

Having a research area like my backyard putting green provides you the opportunity to try new management techniques and products without fear of killing grass.