

## **MANAGING PROBLEMATIC SUMMER TURF DISEASES**

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Plant diseases pose a unique threat to intensively managed turfgrass areas such as golf course putting greens, tees, and fairways. Much like human diseases, plant illnesses and maladies are often brought on or exacerbated by stressful conditions. Highly maintained turfgrass areas are often intentionally subjected to stressful management practices such as frequent low mowing, aggressive cultivation, limited nitrogen fertility, heavy traffic, and extreme environmental conditions. Taken together, these circumstances can predispose plants to infection and increasingly favour pathogen development ultimately leading to devastating disease outbreaks. Luckily, there are numerous, well-characterized management strategies that can help tip the scales back in favour of turfgrass health.

### **NITROGEN FERTILITY**

The backbone of any disease management plan is appropriate and timely applications of nitrogen fertilization. Nitrogen (N) is a component of proteins, chlorophyll, and nucleic acids among other cellular constituents. It directly influences root and shoot growth, carbohydrate concentrations, drought resistance, wear tolerance, shoot density, and recuperative potential. Turfgrass growth responses to nitrogen are often undesirable due to a decrease in ball roll or green speed. Golf course superintendents thus limit nitrogen applications during stressful periods, which undoubtedly compromises plant health and contribute to disease pressure.

Diseases that are directly favoured by nitrogen fertility include:

#### **N deficient**

Anthracnose

Dollar spot

Rust

Red thread

Necrotic ring spot

Summer patch

Leaf spot

Take-all patch.

#### **N Excess**

Brown patch

Microdochium (Fusarium) patch

Snow moulds

Pythium blight

Nitrogen fertility is especially important in managing foliar diseases such as dollar spot, anthracnose, rust, and leaf spot. When plants are actively growing, foliage can often be mown off before infection takes hold. Nitrogen helps to encourage development of new growth to replace diseased tissue as well.

When diseases must be controlled with fungicides, the efficacy of many turfgrass fungicides can be directly influenced by nitrogen fertility. Research has shown when fungicides ‘fail’ to control diseases such as anthracnose or summer patch, it is often due to the lack of nitrogen in the system and not a resistance of the pathogen.

### **WATER MANAGEMENT**

Just as water is important in keeping plants alive, the mismanagement of water can also be a determining factor in disease development and plant death.

**Irrigation:** Proper timing of irrigation can help minimize turfgrass disease by limiting the duration the canopy stays wet. Leaf wetness duration (LWD) is one of the key facets of plant-pathogen interactions which often dictate disease outbreaks. Knowing this, it is often recommended to irrigate turfgrass in the mid-afternoon during hot dry periods of the summer to cool off the plant and supply water when needed most. The plant leaves will also dry the quickest at this time of the day, discouraging further pathogen infection. Mid-day irrigation is not practical on golf courses; therefore, irrigating just before sunrise is a good time to provide the plant with the needed supplemental water and to knock dew and guttation off, thus decreasing LWD.

Conflicting viewpoints can be found regarding the frequency and amount of irrigation best suited for turfgrass disease management. The deep-infrequent versus light and frequent debate has gone on for years with a fair amount of research to support either side. In the heat of the summer, when root systems are often short and especially when pathogens such as summer patch or take-all patch are active, light, frequent applications of irrigation give the plant the best opportunity to survive the stressful heat and drought of the summer. In the spring and fall, when roots are healthier and more robust, irrigation is likely needed less often, and frequent applications may even contribute to additional disease pressure by creating overly saturated environments. Timing is everything, which is why knowledge and forecasting through keen evaluation of soil moisture is suggested to help to quantify irrigation rather than traditional guesswork.

**Drainage:** Adding water to turfgrass is one thing, but getting rid of it is another. Adequate surface and subsurface drainage is crucial for managing *Pythium* diseases, brown patch, anthracnose, and root infecting patch diseases among others. Good drainage on turfgrass surfaces starts beneath the ground with subsurface drainage. The golf course should be routinely audited and monitored after heavy rainfall, and areas that hold water or stay saturated should be slated for additional drainage installation. Practices such as deep tine aeration and verti draining can help with surface water infiltration and have shown to reduce pressure from certain diseases. Like the old wise turfgrass adage says, ‘drainage, drainage, drainage.’

## CULTURAL PRACTICES

Turfgrass as a perennial plant community is subject to unique management practices that can be implemented strategically to favour plant health and avoid disease.

**Mowing:** Mowing at an optimal height is an important first step in mitigating disease pressure. Each species of turfgrass is unique, but newer cultivars of creeping bentgrass for instance are most competitive when maintained around 3.2 mm (0.125 in.). Demands for faster green speeds and tournament-like playing conditions have forced mowing heights to become lower and lower over the years. Excessively low mowing heights not only compromise the plant’s ability to photosynthesize, but hinders root growth and development as well as predisposes the meristematic tissue of the plant to diseases such as anthracnose.

**Rolling:** Supplementing mowing events with lightweight rolling, particularly during the stressful periods of summer has shown to benefit turfgrass health and discourage disease in numerous research studies over the years. Not only has regular lightweight rolling (three or more times per week) shown to directly reduce diseases such as dollar spot and anthracnose, but alternating

mowing and rolling on a daily basis does not significantly reduce green speed compared to mowing every day. Putting greens should be mowed daily when turfgrass growth potential is highest. For cool-season grasses such as creeping bentgrass and annual bluegrass, this is during the spring and fall. In the summer, when cool season turfgrass growth potential is low, replacing some scheduled mowing maintenance each week with a couple of lightweight rolling sessions can aid in managing additional summer stress and hinder disease development.

**Top dressing:** Most superintendents recognize the numerous benefits of light frequent sand topdressing on their putting greens. Diluting organic matter content and increasing water infiltration has shown to greatly reduce the severity of fairy ring; and the direct and indirect effects of this cultural practice can play a significant role in general disease management. For many years, it was thought that sand topdressing may cause wounding or scarring on turf tissues leading to increased disease incidence. This notion is largely false with the minor exception of bacterial pathogens. The majority of turfgrass diseases are caused by fungal organisms capable of directly penetrating and degrading living plant tissue. Wounds are not necessary for pathogen invasion, and in some cases can actually induce an immune response toward would be intruders. Recent research conducted at Rutgers University has demonstrated the effects of frequent sand topdressing on anthracnose. A foliar infection of anthracnose can be overcome, however, should the fungus get into the crown of the plant, remedial or curative treatment is nearly impossible. Thus, burying the crown of the turfgrass plant deeper into the profile with sand topdressing serves to protect the plants from the anthracnose pathogen and lessen overall disease severity.

### **OTHER POINTS TO PONDER**

A key tenant of plant pathology is the disease triangle. For disease to occur, this simplified schematic indicates three things that must be present:

1. A susceptible host.
2. A plant pathogen.
3. An environment conducive to disease.

Of course, the physical and molecular biology that underlies host-pathogen interactions can fill libraries of textbooks; but the basic principles have remained the same. Turfgrass managers aim to control or influence as many of the three corners of the disease triangle as possible, but usually the focus is best on one or two at a time.

### **The pathogen**

It is nearly impossible to eradicate pathogen populations from the turfgrass system due to the ubiquity of fungal and bacterial organisms in the soil. Management strategies that directly target the pathogen side of the disease triangle, such as the use of fungicides and/or biological control organisms, aim to inhibit, antagonize, or out-compete the pathogen(s) of interest. Fungicides or other chemical means of disease control usually possess a specific mode of action that results in toxicity to pathogenic organisms. These chemicals can inhibit growth upon contact with the fungus, or be taken up by the plant systemically and inhibit pathogen entry and survival upon an attempted pathogenic attack. When used properly, fungicides are still the most effective way to control problematic diseases of turfgrass, particularly when environmental disease pressure is high.

## **The host**

The turfgrass plant as a susceptible host in the disease triangle can be managed in such a way that discourages or hinders disease epidemics. Proper species and cultivar selection can serve as the foundation of an integrated disease management program. Plant breeders have researched for decades the heritable traits turfgrass managers' desire such as disease resistance. Cultivars like Merion Kentucky bluegrass with its resistance to the once devastating disease known as striped smut (*français: charbon strié*), revolutionized the turfgrass industry. Resistance to one pathogen usually opens the door to another lesser known disease. In the case of Merion Kentucky bluegrass, the disease that took the place of stripe smut was the root associated necrotic ring spot. Luckily, with recent advances in molecular genetics, researchers are working toward development of plants that contain numerous genes allowing them to elude any number of pathogens that may come their way.

Another way of altering the host plant is through the use of plant defense activators. Research has shown the plant innate immune system contains intricate and complex pathways that can be altered and activated by a number of different physical and chemical stimuli. Products such as acibenzolar-S-methyl, phosphites, and several others exist on the market that claims natural plant resistance activation. At the molecular and biochemical level, many of these products have shown to up-regulate particular resistance-associated genes or markers, however, unless used in tandem with fungicides and sound cultural disease management practices, these products often fail to provide acceptable levels of disease control under real-world, high pressure disease conditions.

Of course, healthy, robust plants are more tolerant to pathogen pressure and, thus, disease. Adequate fertilization, as mentioned above, directly targets the host and improves overall turf health, vigour, and resistance capacity. Research has shown the use of products that incorporate pigments can deliver unique stress reduction on turfgrass stands by selectively mitigating detrimental radiation, improving photosynthesis under high- and low-intensity light, and often times increasing overall carbohydrate accumulation within the plant. Fungicide products help to reduce plant stress before, during, and after pathogen encounters, which undoubtedly allow for a more vigorous stand of turfgrass that is more tolerant to disease pressure.

## **THE ENVIRONMENT**

This article focused on many of the cultural practices turfgrass managers and researchers use which aim to influence the environment and suppress disease. Almost everything that is done on the golf course alters the growing environment. The weather cannot be controlled or in some cases even predicted; however, groundskeepers can make a conscious effort to positively influence plant health through alteration of the growing environment.

**Tree management** and **fan installation** are thought to be the two most effective 'fungicides' available. Air movement and sunlight can make a world of difference in a difficult microclimate. Verti-cutting and sand topdressing reduce organic matter accumulation, thus improving water infiltration and hindering the moist environment many fungal pathogens thrive in. Although some cultural practices are not directed at disease management, but rather playability, many go

hand-in-hand. For instance, dew whipping and rolling deliver a better playing surface for golfers, and are known disease management strategies that should be used as often as possible.

Other ways to alter the growing environment include **pH manipulation** through soil amendments such as sulphur or lime. Depending on the disease complex, these practices can have profound effects on pathogen populations and survivability. Take-all patch, for instance, is a disease favoured by higher pH (greater than seven). Acidifying fertilizers and other chemical amendments can be used to lower the rootzone pH to a less favourable environment for the pathogen and thus limit disease progression.

## TURF FUNGICIDES

Fungicides are to be considered essential tools in keeping your turf healthy. Despite perfect maintenance conditioning, disease may still occur during periods of optimum growing conditions for pathogens and stressful periods on the plant. There are numerous fungicides available, most of which are specifically formulated for use on high value turfgrass areas. Despite their diversity in terms of disease spectrum, mode of activity, and mode of action, fungicides should ideally be used preventatively and judiciously by incorporating multiple modes of action into a program. If curative situations occur, combination of fungicides as pre-mixed or tank mixed partners work best in achieving adequate control. Special attention should be put toward fungicide selection, sprayer calibration, water volume, water quality (pH), and climatic conditions as they can all affect, to various degrees, a fungicide's performance.

It is important to keep the disease triangle in mind, and target as many of the three corners in as many ways possible for successful management of difficult turfgrass diseases. Turf managers and researchers continue to work on new and innovative ways to control the most troublesome turf pathogens through breeding, genetics, cultural, chemical, and biological means. As technology advances at its current pace, the industry can look forward to many new and exciting tools that will soon be available.

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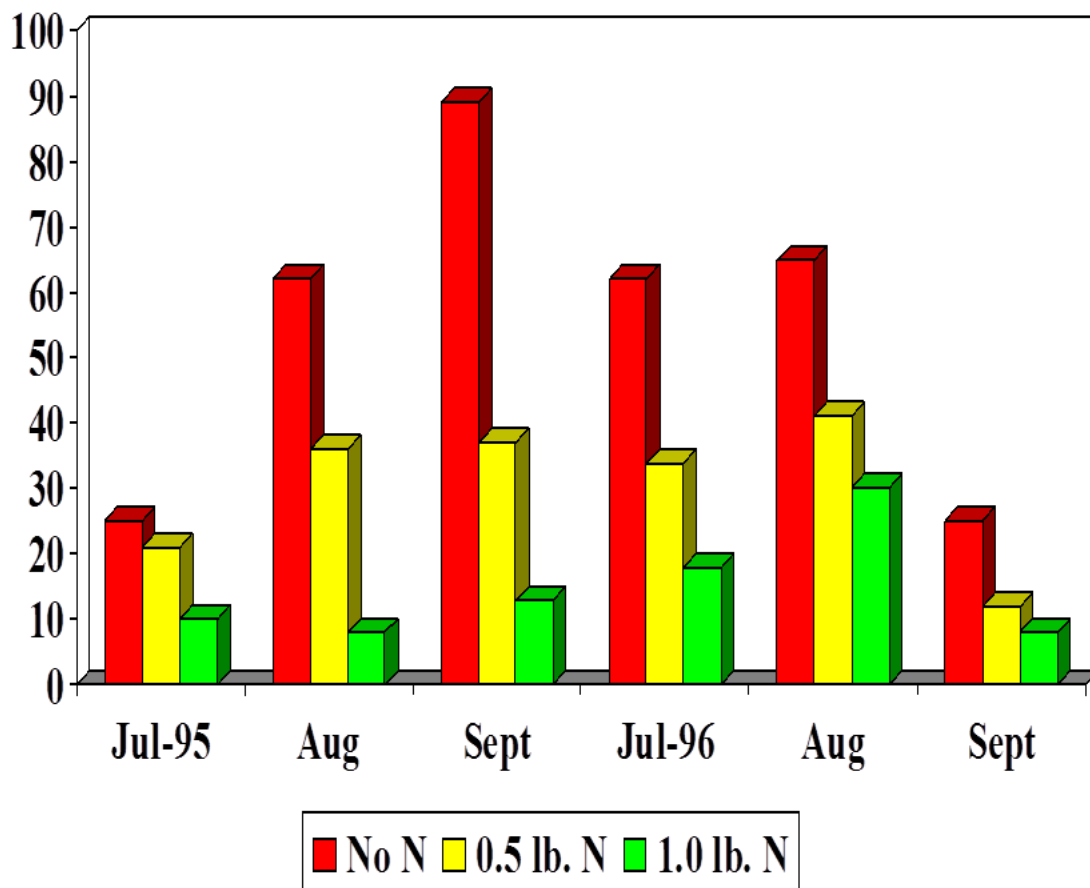
[PHOTOS]



Basal rot anthracnose on an under-fertilized annual bluegrass putting green. Note the healthy, more tolerant creeping bentgrass growing among the infected, copper-colored *Poa annua*. Photo courtesy of Derek Settle, Bayer CropScience.



Pythium blight damage associated with overwatering and hot, humid conditions. Damage can occur very quickly, and note the disease can spread with water and mechanical traffic. Photo Courtesy of Derek Settle, Bayer CropScience.



Dollar spot incidence as influenced by nitrogen fertility. Note as nitrogen rates (per 1000 sq. ft.) increase, dollar spot severity decreases. Data from Golembiewski et al, (1998).





Specially-designed products for highly maintained turfgrass such as Bayer's StressGard Formulation Technology can aid in disease reduction through stress mitigation. Many diseases including anthracnose and summer patch are routinely associated with stressful conditions. Photo courtesy of Rob Golembiewski, Bayer CropScience.



Fungicides are still necessary to control widespread disease outbreaks. Dollar spot can become very severe if not treated. The above picture showcases the extent of damage caused by dollar spot in an untreated research plot while the surrounding plots have been preventively treated with a variety of effective fungicide applications. Photo courtesy of Rob Golembiewski, Bayer CropScience.



Diseases such as *Microdochium* patch (aka *Fusarium* patch) can be more severe when nitrogen fertility is high during late fall/early winter months. Careful consideration toward fertility inputs and moisture management are key facets to controlling this disease. Photo courtesy of Rob Golembiewski, Bayer CropScience.