



Tackling Take-all

PHOTOS: JOHN KAMINSKI, ASST. PROF OF TURFGRASS SCIENCE AT PENN STATE

Masters student Ben Evans provides a backgrounder on one of turf management's most debilitating diseases, Take-all patch, and finds that pH reduction and cultural practices can go a long way to controlling its impact.

Above: Symptoms of Take-all patch can easily go unnoticed until drought or heat stress conditions arise. The disease is identified by dead, yellow to reddish brown, sunken circular patches, which measure from a few inches to several feet in diameter

Right: With the outward movement of Take-all patch, resistant species may fill in the dead voids, which gives a frog-eye appearance

Take-all patch is caused in bentgrass greens by the fungal pathogen *Gaeumannomyces graminis* var. *avenae*. Severe outbreaks can damage large areas of turf, causing tremendous damage to the visual appeal of a golf green. The fungus inhabits the soil and causes damage under very narrowly defined conditions and particularly favours bentgrass (*Agrostis* spp).

This disease derives its common name of Take-all as it tends to 'kill all' plants within a certain area, leaving voids of dead turf within its margins. Originally classified under the genus *Ophiobolus*, the disease was first observed on turf in 1937 in Holland, but it wasn't until 1980 that it was named *Gaeumannomyces* Patch, or Take-all patch.

There are five species of *Gaeumannomyces* which occur on turf:

- *G. graminis* var. *graminis*;
- *G. graminis* var. *avenae*;
- *G. graminis* var. *incrustans*;
- *G. graminis* var. *tritici*; and
- *G. graminis* var. *wongoonoo*.

While their appearances are all similar to the human eye, they are often distinguished by their preference of hosts (see Table 1). Take-all patch on bentgrass greens is caused by *G. graminis* var. *avenae*, the most common type of Take-all. It can also infect ryegrass, some fescues and in Australia has also reported to have attacked Tifdwarf.



IDENTIFICATION

Symptoms of Take-all patch can easily go unnoticed until drought or heat stress conditions arise. The disease displays no distinct leaf spot or lesion common with foliage infections. The disease is identified by dead, yellow to reddish brown, sunken circular patches, which measure from a few inches to several feet in diameter. Freshly affected plants become bronze in colour and are easily pulled out from the surface. As the disease affects underground parts, this also makes visual diagnosis difficult.

With the outward movement of the patch, resistant species may fill in the dead voids, which gives a frog-eye appearance. Commonly, weeds such as *Poa annua* and many broadleaf weeds can fill in these voids which makes management even more onerous. The patches resemble the blue-grey wilt appearance which is due to impaired root function.

The disease is readily identified from other patch diseases. Black strands of mycelium are visible under the base of leaf sheaths or on the surface of roots, rhizomes and stolons of infected turf. These dark brown to black ectotrophic runner hyphae can be observed with a small hand lens of 18x magnification. Once infected, roots turn dark brown to black and cease to function normally. Mycelium growth is limited, comprising fine, greyish hyphae. The disease does not infect leaves.

A common identifying feature on stolons of infected plants are perithecia. These are abundant, brown to black sacs, with numerous cylindrical curved beaks extending through leaf sheaths. Within these sacs are 'asci' which are essentially the seeds of Take-all patch. These sacs eject the seeds on to nearby plants, where a new infection site begins.

LIFE CYCLE

The disease spreads via outward growth of the organism from plant to plant, over rhizomes for instance. Dissemination over great distances can be achieved whenever a piece of ectotrophic fungi attaches itself to turf cultivation equipment, such as coring machines or vertical mowing equipment. The disease survives adverse conditions as a saprophyte in thatch.

Infection is a two-step process. Dark brown hyphae branch and form hyphopodia and colonise the cortex and the root. Then, dark brown runner hyphae grow on the surface of roots. This results in the death of the epidermal and outer cortical cells of roots. As the infection process continues, vascular hyphae and dark brown necrotic streaks develop. All tissues in affected roots turn brown and cease to function. This is why watering will not alleviate the wilt associated with this disease.

G. graminis var. *avenae* grows essentially wherever bentgrass is grown. Although the pathogen is favoured by cooler climates, it is most severe in the range of 15°C -24°C. Other members of the *Gaeumannomyces* family, such as *G. graminis*

var. *graminis* and *G. graminis* var. *wongoonoo*, responsible for bermudagrass decline and Wongoonoo patch respectively, prefer temperatures over 25°C.

The disease is favoured by full and very high sand constructions (>80 per cent sand) with high pH (>7). Greens which have been heavily limed seem to favour Take-all patch. There is good correlation between rhizosphere pH and disease incidence. The disease was mainly found in the top 12-25mm of topsoil.

MANAGEMENT

Control of the disease can be quite difficult, as the conditions which give rise to Take-all also generally favour bentgrass growth. Pathogen activity is seen on soil temperatures around 15°C in spring and 20°C in autumn, which also favours bentgrass root development and elongation.

During infection, any process which decreases bentgrass root development should be avoided, such as excessive irrigation and soil compaction. Aeration to promote free water removal and gas exchange are key considerations. As the disease over-winters in thatch and decaying stolons, thatch management is a key consideration in limiting Take-all reoccurrence. Vertical mowing and dusting with non-lime topdressing materials and judicious nitrogen applications in autumn will limit thatch build-up.

The disease is commonly controlled by using acidifying fertilisers and by maintaining a pH at 5.5-6.0 (Smiley et al. 2005). Liming should only be applied to rectify severe acidity, where only coarse lime should be used to avoid severe changes in pH. In turf management, alterations of pH have been successful in combating many diseases. By altering a soil's pH, there is a shift in microbial activity. It is these microbes which are antagonistic to the fungi which incite many diseases, such as Take-all, and limit its occurrence.

A review of literature suggests there is a close correlation between the incidence of Take-all patch and the application of lime or alkaline fertilisers, or even calcareous sand. There is a decrease in disease severity when applications of acid inducing fertilisers are applied to turf. Take-all patch is most frequently seen after liming to correct over-acidity.

Applications of manganese (Mn) and copper (Cu) in trace element applications has shown some promise in reducing Take-all incidence. The increased susceptibility of bentgrass to Take-all patch is thought to be a result of Mn deficiency. This may be related to the role of Mn in lignin production and the importance of lignification of cell walls as a defensive mechanism against this disease (Heckman et al. 2003).

Researchers in the United States found plots treated with high rates of Mn and Cu (2.04 and 0.68kg/ha respectively) exhibited less disease than turf receiving no applications at all. In the two year

study, disease incidence was decreased from 20 per cent of untreated turf to five per cent with the high rate of Mn and Cu (Hill et al. 1999).

Another research study which investigated the use of Mn on a bentgrass fairway infected with Take-all patch, concluded Mn did in fact reduce and suppress the foliar symptoms of Take-all patch on bentgrass turf. A rate of 2.25kg/ha was generally effective. Re-application of manganese fertiliser on a yearly basis was effective in relieving foliar symptoms.

Mn has a low mobility in plants once it is incorporated into shoot tissue. Therefore a large portion of foliar applied Mn would likely be readily immobilised in the upper portions of the leaves once foliar uptake occurs and would be removed via mowing. Another benefit of lowering pH is that it makes Mn more available to the plant, helping to further combat Take-all.

Resodding of affected areas is a viable option if infections are small. The infected soil must be removed from the site and all tools used in the resodding process must be cleaned thoroughly, as the slightest strand of mycelium left behind will begin a new infection.

Take-all patch is very weak in competing in the soil and is easily antagonised by other organisms. In new greens, with little microbial activity, Take-all can be rampant. As the disease colonises newly established greens of high sand content or recently sterilised greens, there is general consensus that the disease establishes in soils with little microbial antagonism.

Turf researcher Richard Latin (2005) reported a general decline in Take-all incidence over the course of a five-year study. When his trial plots were juvenile, Take-all was rampant, but over the years as microbial populations built-up to antagonise the fungus and sound stress management procedures were applied over summer months, Take-all was rarely seen.

REFERENCES

For a full list of references for this article please contact author Ben Evans via email bennyevans_au@yahoo.com.au



A common identifying feature on stolons of infected plants are abundant brown to black sacs, or perithecia, which contain 'asci' which are essentially the seeds of Take-all patch

TABLE 1. GAEUMANNOMYCES SPECIES

Isolate name	Common name	Temp range	Preferred host
<i>G. graminis</i> var. <i>avenae</i>	Take-all patch	20°-25°	Bentgrass, ryegrass and fescue
<i>G. graminis</i> var. <i>graminis</i>	Bermudagrass decline	20°-30°	Couchgrass, kikuyu, zoysia, centipede grass, seashore paspalum, buffalograss, ryegrass
<i>G. graminis</i> var. <i>incrustans</i>	Take-all patch Zoysia root rot	15°-25°	Wintergrass, Kentucky bluegrass, couchgrass, zoysia, fescue
<i>G. graminis</i> var. <i>tritici</i>	Take-all	20°-25°	Largely affects wheat, reported on some turfgrasses, mostly bentgrass
<i>G. graminis</i> var. <i>wongoonoo</i>	Wongoonoo Patch	25°-30°	Buffalograss, couchgrass