



TURFAX™

Volume 7, Number 4



July–August 1999

of the International Sports Turf Institute, Inc.

The International Newsletter about Current Developments in Turfgrass

IN THIS ISSUE

- Understanding Take-All Patch
- *Poa annua* Terminology Clarified
- Petroleum Spill Injury Symptoms
- Vegetative Planting Rates for Perennial Turfgrasses
- Annual Bluegrass Resistance to Dinitroaniline Herbicides Identified
- The Amazing Grass Plant
- Research Summary: Treatments of Petroleum Spills on Bermudagrass Turf
- Trees and Government
- J.B. Comments: Failure to Use Chemical Soil Test Findings
- Ask Dr. Beard

Understanding Take-All Patch

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Take-all (formerly known as *Ophiobolus*) patch is incited by *Gaeumannomyces graminis* (Sacc.) Arx & Olivier var. *avenae* (Turner) Dennis and almost is exclusively a disease of creeping and colonial bentgrass turfs. It has been observed in annual bluegrass in England on rare occasions. Take-all was first reported in Holland in 1937 on a bentgrass putting green, but its occurrence in the United States was not documented until 1960, in western Washington. It was not until the 1970s that the disease was reported in the eastern United States. **Take-all is now known to occur anywhere bentgrass is grown. The fungal pathogen attacks roots and stems, and there are no distinctive leaf spot or sheath lesions.**

Take-all is most common on newly constructed golf courses, particularly those carved out of woodlands, peat

bogs, or other areas that have not supported crops or grasses for decades. This disease can be especially damaging to rebuilt greens or tees on old golf courses or where methyl bromide has been used for renovation. Take-all also can be imported on infected bentgrass sod that is installed on new high-sand mixes or existing mineral soils. The disease tends to spread more rapidly and occurs with greater severity in sandy soils. Take-all may appear as early as the spring immediately following an autumn seeding. It generally becomes most severe in the second year following seeding.

The pathogen actively attacks roots during cool and wet periods, but symptoms may not appear until the advent of warmer and drier conditions. Symptoms of the disease are most conspicuous from late April throughout the summer, and may recur in autumn. Bentgrass affected by take-all in the spring may recover by summer. However, if irrigation is withheld, those areas affected in the spring are the first to die from drought stress. Initially, the circular patches of take-all affected bentgrass are only a few inches (3–5 cm) in diameter and reddish-brown or orange-bronze in color. Turf in affected patches may first develop the blue-gray color associated with wilt. This is due to the impaired ability of roots to take up sufficient amounts of water. Patches may increase to two feet (0.6 m) or more in diameter, particularly on chronically affected bentgrass sites. **Most patches range from 3 to 12 in. (7–30 cm) in diameter**, but they may develop in tight clusters that give the appearance of a single, large, 2 to 3 foot (60–90 cm) diameter patch. Patches also may coalesce, resulting in large, irregular areas of dead turf. When the disease is active, the perimeter of the patch usually assumes a bronzed appearance, and the turf eventually turns a bleached or tan color. Patches also frequently appear reddish-brown in color, and bronzing may be absent. The small, circular patches increase in size over a number of years, and dead bentgrass in the center of the patch may be colonized by weeds if herbicide use is restricted. Sometimes, small horseshoe-shaped crescents are

Continued on page 2

...Take-All Patch

Continued from page 1

associated with take-all. On rare occasions, the turf turns brick-red and thins out in a nonuniform pattern. Because the fungus attacks the root system, turf in affected areas is easily detached and is similar to the type of damage caused by white grubs.

In most cases, the disease will naturally decline over time, presumably due to a buildup of microorganisms that antagonize or in some other way prevent *G. graminis* var. *avenae* from damaging roots. This explains why take-all is normally not a problem on older golf courses. There are, however, exceptions. A 100-year-old golf club in Massachusetts developed take-all after they installed their first irrigation system (Dr. N. Jackson, personal communication). Soil at the site was high in lime. Furthermore, golf courses with a past problem with take-all may see the disease redevelop following a heavy application of lime. And, as previously noted, rebuilt tees or greens, the use of methyl bromide, or the installation of infected sod are associated with take-all outbreaks on older golf courses. The decline phenomenon may occur within 3 to 7 years from the time that the first disease symptoms were observed. During the decline phase of take-all severity, patches appear reddish-brown or chlorotic (yellow) and turf may thin out. Take-all, however, may persist indefinitely in highly buffered alkaline soils or where the irrigation water has a high pH.

Management of Take-All

There is an interesting relationship between soil pH and take-all. **This disease can occur over a wide range of soil pH's, including acidic soils, but it is most severe and persistent where soils are in the neutral to alkaline range (i.e., pH>7.0).** Acidification of soil with ammonium forms of nitrogen fertilizer is the primary cultural approach to managing take-all. Nitrate forms of nitrogen, such as KNO_3 , CaNO_3 , and NaNO_3 , however, can intensify take-all and other patch diseases caused by root attacking fungi. The early studies that were used to establish acidification as a method of control involved excessively high levels of nitrogen (e.g., 8 to 12 lb N/1000 ft²/yr or 400 to 600 kg N/ha/yr). It is now known that as little as 3.0 lb N/1000 ft²/yr (150 kg N/ha/yr) from either ammonium chloride or ammonium sulfate significantly reduces, but does not eliminate take-all. **Ammonium sulfate or ammonium chloride should be used as the primary N source for at least two years and perhaps longer where the disease is more persistent.** Ammonium-based fertilizers will provide very good winter color in turf, but they also encourage growth, and therefore cause slower putting green speeds and increased mowing into early winter. Sulfur is used to suppress this disease in the Pacific

Northwest; however, ammonium-based N fertilizers remain the best and safest choice for take-all management in most regions of the United States. Elemental sulfur can be phytotoxic to bentgrass, particularly in the northeastern United States. The sulfur in ammonium sulfate (i.e., SO_4 anion), however, is oxidized and leaches, causing no damage to bentgrass.

Acidification of the rhizosphere (i.e., the root surface and microenvironment) is believed to be the primary factor responsible for alleviating take-all with ammonium forms of nitrogen. It has been suggested that acidification of soil water either directly reduces growth of the take-all fungus or favors growth of other microorganisms that effectively compete with or in some other way antagonize *G. graminis* var. *avenae*. More recently, manganese oxidation by microbes in soil has been linked to increased take-all in wheat. Manganese sulfate applied at 1 to 2 lb Mn/ac (50–100 kg Mn/ha) for a total of 6 to 8 lb Mn/ac/yr (300–400 kg Mn/ha/yr) can reduce the severity of take-all (Dr. B.B. Clarke, personal communication). Uptake of Mn by the plant may be improved by using a wetting agent. Acidification apparently also reduces the ability of microbes to oxidize manganese, and the resulting increase in manganese availability for root uptake assists plants in their defense against the take-all fungus.

Phosphorus (P) and potassium (K) also have been linked to reducing take-all severity. Phosphorus should be applied even when soil tests indicate moderate (>50 lb P/ac or >56 kg P/ha) or high P levels. For best results, an ammonium-based nitrogen fertilizer should be applied with P and K in a 3:1:2 ratio. The use of lime or topdressing at a pH above 6.0 should be avoided. Do not use topdressings that are augmented with lime. Thatch and soil compaction should be controlled through core cultivation and/or vertical cutting. Core cultivation, however, should be performed when symptoms are not evident and should be delayed if it causes lifting of the bentgrass turf. Check your irrigation water for pH. In extreme cases, acid injection of irrigation water may be required. Frequent syringing of affected areas often is required in the summer to prevent death of plants whose root system has been significantly damaged by the pathogen. Finally, the use of preemergence herbicides and ethofumesate (Prograss®) should be avoided where take-all is a problem.

Azoxystrobin (Heritage®), fenarimol (Rubigan®), propiconazole (Banner®), or triadimefon (Bayleton®) applied twice in late autumn or early winter and again in April and May should provide some protection against take-all. For additional suppression, these fungicides may have to be applied two to three times at 21-day intervals at the onset of symptoms in the spring. 