Figure 1: Initial symptoms of take-all on fine turf

Figure 2: Classic symptoms of take-all

RESEARCH UPDATE

Neil Baldwin, plant pathologist at the Sports Turf Research Institute, continues his research and, in this article, describes the cause of take-all patch disease and its prevention and control.

FOR over a century, take-all patch disease has been recognised in agriculture as a problem of global importance, limiting significantly the productivity of pastureland and cereal crops.

On British golf greens however, take-all was relatively unknown until the 1950's when, to correct the extreme acidity of fairways of heathland courses, heavy applications of lime were made. Liming encourages take-all, and severe outbreaks were recorded.

During the next 25 years the damage done by liming was recognised and as this practice ceased, take-all declined. However, for reasons discussed later, take-all is once again on the increase.Consequently, due to the very destructive nature of take-all, its persistence and the absence of a chemical control measure, take-all is regarded as a potentially very serious problem in turf management.

Take-all is caused by the fungus Geaumannomyces graminis, until recently named Ophiobolus graminis, hence the old common name for the disease, Ophiobolus patch. To standardise the names used for diseases on a worldwide basis, the correct name for this disease is now 'take-all' and the use of all previous names has been discontinued.

On golf greens, the disease often appears initially as saucer shaped, slightly depressed bare areas (Figure 1) consisting mainly of dying bentgrasses. Accurate diagnosis of the disease at this early stage can only be made by laboratory examination. If help is needed, send a turf sample to the STRI.

These small patches may then enlarge into a ring, measuring up to 30 cm in diameter (Figure 2), of bleached or bronzed bentgrasses, the centre of each ring being occupied by plants resistant to the disease such as fescues, annual meadow-grass and broad leaved weeds. Eventually, adjacent rings may coalesce, resulting in large irregular patches on greens or fairways (Figure 3). Although the disease is active only during the warmer parts of the year, the symptoms of attack usually appear in late summer.

DISEASE CYCLE

While most greenkeepers are aware that it is the bentgrasses that are very susceptible to take-all and consequently suffer most damage, the way in which the disease attacks the plant is not widely understood.

Take-all survives the winter in the soil as spores and dormant mycelium awaiting more favourable conditions the following spring.When warmer soil temperatures arrive, the fungus penetrates the vascular tissues of the plant, thus preventing the uptake of water and nutrients. Infected roots then turn brown and die and consequently affected turf may be easily detached from the surface. The disease then spreads up the plant as runner hyphae (thick mycelial threads which run in lines on the surface of the plant) which eventually penetrate the crown and kill the plant. The disease then produces flask shaped structures (perithecia) filled with spores which can then be spread by wind or water-splash to new areas.

FAVOURED CONDITIONS

When a greenkeeper first experiences the disease on his course the first question he may ask is "Why has the disease suddenly appeared here?" In fact the disease has probably been present all the time.

During the 1970's an extensive survey of British golf courses revealed that Gaeumannomyces graminis is nearly always present in turf at low population levels, even if the symptoms of disease attack have not been seen. Thus, if the fungal inoculum with potential to cause take-all is there, the disease can develop once turf conditions are favourable.

There are two main reasons why take-all in most situations remains at these naturally low disease levels.

Firstly, present in the turf and soil are many other fungi and bacteria that are antagonistic to take-all and suppress the disease to such an extent that its pathogenic activities are almost totally inhibited.

Any turf management practice that is detrimental to these antagonists may consequently lead to an outbreak of take-all. For example, sand-constructed greens are naturally low in antagonists and as such, are prone to take-all. The use of sterilised turf or materials in which the antagonists have been killed also aids rapid colonisation by take-all.

Secondly, a strong relationship between turf pH and take-all has been identified. It has now been well established that a sudden raising of the turf pH by the (often not deliberate) application of alkaline materials can lead to severe take-all attacks.

On golf courses, the application of lime is rare and generally only acidic fertilizers are used. However, there are several other possible sources of alkalinity. If water is taken from irrigation bore holes it can be hard, i.e. contain lime. Thus, every time the watering system is used, lime is being applied. However, in most cases this is not of major concern as not all water classified as "hard" has a high enough lime content to appreciably raise the turf Ph. Another important source of lime is the sand used either in construction or top dressing. If this sand has a high lime content then, particularly in wet regions where the lime can go into solution quickly, a rapid increase in turf pH can occur.

PREVENTION AND CONTROL

It must be emphasised that once the disease has become established, there is no effective control measure.

At present two fungicides, namely carbendazim and

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chlorothalonil, have a manufacturer's recommendation for control of take-all. At best these chemicals will give short term suppression of the disease only, and sometimes, following an application of these materials, the take-all will reappear at higher levels than previously. It is thought that the reason for this is that the fungicide will inhibit fungi in the soil that are antagonistic to the take-all and consequently this biological control mechanism is lost.

Consequently, fungicides may inhibit the process of take-all decline (see later) and therefore applications should be kept to a minimum.However much can be done to lessen the severity of a take-all attack. All efforts must be aimed at preventing outbreaks.

Firstly, the conditions under which the disease is likely to occur must be recognised. The sand construction method of building greens appear particularly vulnerable as sand can support only a low population of antagonists. There is some evidence that new courses built in woodland areas (where soils are low in antagonists) are also prone to the disease. By far the best prevention of take-all can be achieved by careful management of turf pH. Any practice that will rapidly increase turf pH should not be used. Determine the lime content of sands used for construction, bunkers or top dressing. Also, be aware of any other possible sources of alkalinity, e.g. fertilizer and irrigation water.

A long term solution to take-all is offered by a phenomenon known as take-all decline, in which, given the right conditions, the disease will become less severe and disappear of its own accord. Consequently, once the disease has become established, our aim must be to establish these conditions so that the eradication of take-all is achieved as quickly as possible.

TAKE-ALL DECLINE

The decline of take-all takes place when the disease, after being present in an area for a number of years, apparently disappears, even if no active control measures have been taken.

In this country, three years may elapse before the disease becomes severe and may then be present at significant levels for a further one or two years.

Associated with this increase in severity of take-all is a build up of antagonistic fungi and bacteria in the soil.

Eventually the antagonists reach a point where they are able to inhibit the take-all and consequently the disease declines. These antagonists can be divided into two groups. Firstly, bacteria, certain soil fungi such as Trchoderma spp and strepto-mycetes which are able to produce antibiotics and thus inhibit the take-all. Secondly a fungus known as Phialophora has been shown to colonise roots and thus leave little available root for take-all attack.

Experiments are in progress at the STRI in which laboratory cultures of fungi have been added to turf infected by take-all in an attempt to boost this process of decline.

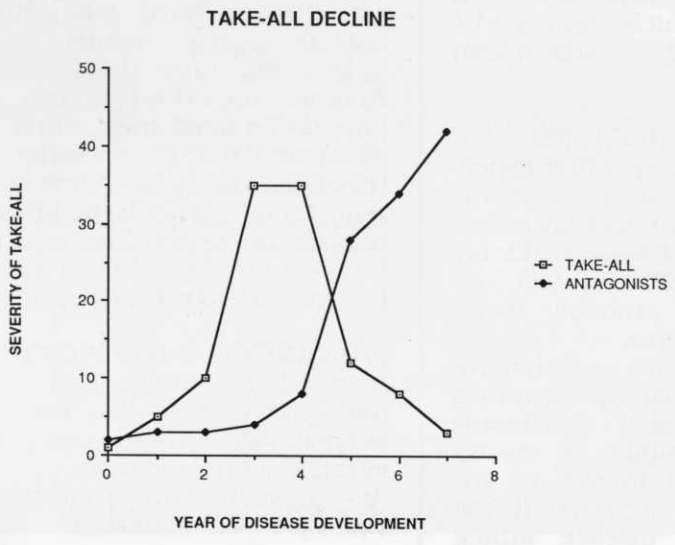

Figure 4: Take-all decline

Figure 3: Extensive take-all damage

Take-all decline can be promoted as follows: As new outbreaks of the disease occur rarely in acidic turf, take-all can be discouraged by application of calcined sulphate of iron.

Application of fungicides should be kept to a minimum as they may inhibit the build-up of antagonists responsible for take-all decline. Outbreaks of fusarium patch disease can be prevented to a great extent by cultural control methods, thus minimising the need for fungicides.

Ensure healthy vigorous turf growth by supplying essential nutrients. Phosphates promote good root growth (and consequently discourage take-all) and potassium is generally regarded as beneficial as it enables the plant to withstand disease attack. Whilst these elements are often present at adequate levels in most greens, chemical analysis of soil samples in cases of take-all outbreak can determine the need for any fertilizer applications.

G. graminis, the causal fungus of take-all, survives unfavourable periods on dead plant material in the thatch layer. Remove excessive thatch by mechanical operations, e.g. hollow tining and scarification.

Take-all is usually most severe on wet, water retentive turf, as the disease spreads in water. Attention to drainage is consequently important.