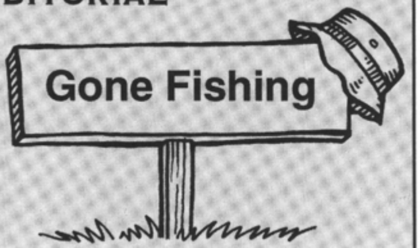
EDITORIAL



This will be the last issue of the *Sports Turf Manager* for which I will be your Editor.

Fifty years ago this week I was completing my first semester at the University of Saskatchewan. Thus began a career which has been dedicated to trying to grow two blades of grass where one grew before. It does not matter whether that grass species was wheat or corn, or in latter years, turf species.

It has been an interesting half century, sometimes frustrating, most often rewarding, particularly when some new technology was implemented, in part as a result of my efforts. Even more rewarding was when a student, a farmer, or a turf manager received recognition for his or her achievements as a result of some assistance I may have been able to give them.

The last six years have been among the most rewarding as many hours, yes, days and weeks, have been spent assisting the Sports Turf Association in becoming a recognized part of the turf industry.

Why go fishing when I am not a fisherman.

The basic reason is that my well of ideas which has enabled me to fill the pages of the *Sports Turf Manager* has run dry. While I enjoy writing, the pressure of deadlines and reminders that an issue is overdue reduces that enjoyment to the negative side.

Someone will be taking on the role of Editor. The success he/she will have will depend on the assistance each and every member of the STA is willing to provide. The *Sports Turf Manager* is well accepted as an informative turf publication. It is now up to each of you whether it continues to be a success.

Black Layer Formation in Turf

Characteristics, Causes and Cures

R.W. Sheard, P.Ag.

The occurrence of black layer in turf for sports facilities has been a continuing problem over the past two decades. Generally the condition has been associated with construction of the fields using U.S.G.A. Green Section specifications or variations thereof. The condition is recognized by chlorosis and die back of the turf which can not be identified as a nutritional or pathogenic problem but which appears associated with it certain characteristics of the root zone.

What are these characteristics?

As the name suggests the condition is black discolorations on the soil particles and slime materials in the root zone which occur as continuous horizontal plates of varying thickness or vertical columns of black, often slimy, root zone material. Associated with the black layer are unpleasant swampy or sewer like odours; even that of rotten eggs which is the aroma of hydrogen sulphide.

The black layers may be from 0 - 10 cm below the surface. The layers may range from 2 to 7.5 cm thick where they occur at or near the surface to 1 to 3 cm thick where they are deeper in the profile. The affected areas may be associated, but not necessarily, with minor depression in the playing surface.The affected areas have a reduced infiltration rate, combined with a reduced hydraulic conductivity. Due to the black slime of bacteria - metal complexes the condition is often referred to as a "black plug layer".

While generally a condition that occurs on sand based root zones, it is also found in natural soils where a program of sand topdressing has been employed to control thatch or modify poor physical conditions. In the latter case the black layer generally occurs at or near the surface

The turf growing on the affected areas dies in a relatively nondescript pattern. The grass may die rapidly by turning a straw to reddish-straw or bronze colour; or occasionally, the affected turf may become chlorotic before dying.

A parallel phenomenon is know to occur in water wells and in drain lines. In water wells slime producing microorganisms proliferate on the screens of sand points and out into the surrounding aquifer. This brown to black slimy growth gradually becomes sufficiently dense enough to plug the screen and reduce the water flow. When tile lines are placed in high iron content soils and backfilled with high organic content top soils a reddish brown slime deposit occurs within the tile which eventually plugs the tiles. In the first case the colour is associated with reduced manganese whereas with the tile lines the material is precipitates of reduced iron compounds.

What are the causes?

Many theories have been promoted for the formation of the black layer but they all accept the basic cause is an anaerobic condition; that is, a lack of oxygen in the soil atmosphere. Work at Michigan State has provided rather definitive data that the anaerobic condition results in the reduction of sulphate sulphur by sulphur reducing bacteria to sulphides. The reducing conditions created by the responsible bacteria in turn results in the formation of iron and manganese suphides, the latter causing the black colour. Also associated with the reduction of sulphur compounds is the formation of hydrogen sulphide which gives rise to the "rotten egg" odour. Furthermore, hydrogen sulphide is a weak acid which can be very toxic and damaging to the turf root system

There are four prerequisites necessary for the formation of the black layer: 1) an anaerobic (oxygen deprived) atmosphere in the soil, 2) an organic material available for microbial decomposition, 3) a source of sulphur compounds, and 4) the occurrence of sulphur reducing bacteria. Without any one of these conditions the black layer will not form.

The first condition is satisfied any time you have a poorly drained or waterlogged condition. The waterlogged condition may result from a perched water table or a permanent water table caused by a number of factors. With regard to the second prerequisite decomposable organic material is always present in soils where the root system is in a continuing process of regeneration. Sulphur compounds occur in all soils and are constantly being added as a product of acid rain and in fertilizers. Sulphur reducing bacteria are found in all soils and can soon be spread by dust to pure sand root zones and rapidly proliferate when the conditions are right.

What are the cures?

It is obvious from the four prerequisite noted above that one, the occurrence of sulphur reducing bacteria, cannot be eliminated. Likewise the occurrence of decomposable organic material cannot be avoided. Steps, however, can be taken to reduce the impact of the other two.

The ultimate cure is in the beginning, during construction of the facility. At this stage the design and construction should be to insure adequate drainage to avoid potential anaerobic situations. Prudence requires that the final contouring be done on the subgrade, not the final surface. Thus the depth of the root zone will be uniform and the water content will remain constant across the field with no localized wet spots.

G.T.I.

Table 1: The formation of black layer and turf quality resulting from the source of nitrogen used for turf production under poorly drained conditions.

Nitrogen Source	Black Layer Rating*	Turf Quality
	(ave. 25 labels)	(rating**)
Ammonium sulphate	3.36	1.96
Urea	3.08	3.44
Ammonium nitrate	0.76	0.68

*On a scale 0 -4, where 0 was no peg discoloration

** On a scale 0 -5, where 0 was no injury and 4 was death of the turf.

The ultimate cure is in the beginning, during construction of the facility.

As part of the system to remove excess water is the system used to provide water - the irrigation system. Excess irrigation through reliance on electronic gadgets and not through thoughtful use of weather data adds to the drainage problem.

At the construction stage uniform, off-site mixing of the sand, organic source and any soil materials is essential to avoid localized interruption in drainage flow. When a cross section of the root zone has the "marble cake" appearance one may be suspicious of poor mixing being the cause of the black layer. Some designers of fields will place 20 cm of pure sand below a final 10 cm of sand:soil:organic mix - "the two layer cake." Again a condition for a perched water table is created, which in combination with the other three prerequisite conditions may lead to black layer.

Since the black layer condition reflects a lack of oxygen in the root zone and as it occurs in the top 10 cm of the profile, deep coring, with hollow tines, and removal of the cores will give temporary relief. Observations by sports turf managers have found the black layer to disappear in the area of the core hole and in the core itself as it is exposed to the atmosphere.

Where topdressing is practiced it is imperative that the material used conforms as closely as possible to the existing material to avoid layering. Changing topdressing materials from year to year result in the "multi-layered cake."

The use of nitrate fertilizers can afford some relief. Work by Drew Smith at Saskatoon demonstrated that a nitrate source of nitrogen could alleviate the condition. The nitrate ion acts as a substitute for oxygen under the waterlogged conditions associated with the black layer. Using wooden plant labels which discoloured according to the degree of black layer formation, he assessed the effect of sources of nitrogen applied to turf growing in pots of course sand which were kept in an waterlogged condition for approximately six weeks (Table 1). The data clearly show nitrate forms of nitrogen were superior to urea and ammonium sulphate in deterring black layer formation.

When black layer is a problem avoiding sulphur containing fertilizers by substituting nitrate carriers for the nitrogen source will provide some degree of relief.

My thanks to Pam Charbonneau for her extensive file on the Black Layer.