CHALKBOARD

TIPS FROM THE PROS

THE BLACK LAYER: ONE SYMPTOM OF OXYGEN- DEPLETED SOIL

By Dr. Houston B. Couch

If we are going to deal effectively with the black layer problem that is being reported in various parts of the U.S. and Canada, we should be devoting our energy toward research into the cause. . . anaerobiosis, or life in the absence of air. . . instead of one symptom, the black layer.

Anaerobiosis is a dynamic series of events which take place in an oxygen-depleted environment. When soil becomes anaerobic, there are significant changes in both the form and the solubility of certain nutrient elements. While these nutrients are beneficial in their standard form under normal conditions, they can become toxic under anaerobic conditions. In a reduced state caused by lack of oxygen, these elements may be taken up by the plant more rapidly than they can be metabolized, thereby becoming toxic.

In addition, the root systems of plants do not function properly in anaerobic soils. Their ability to absorb water and nutrients may be reduced significantly.

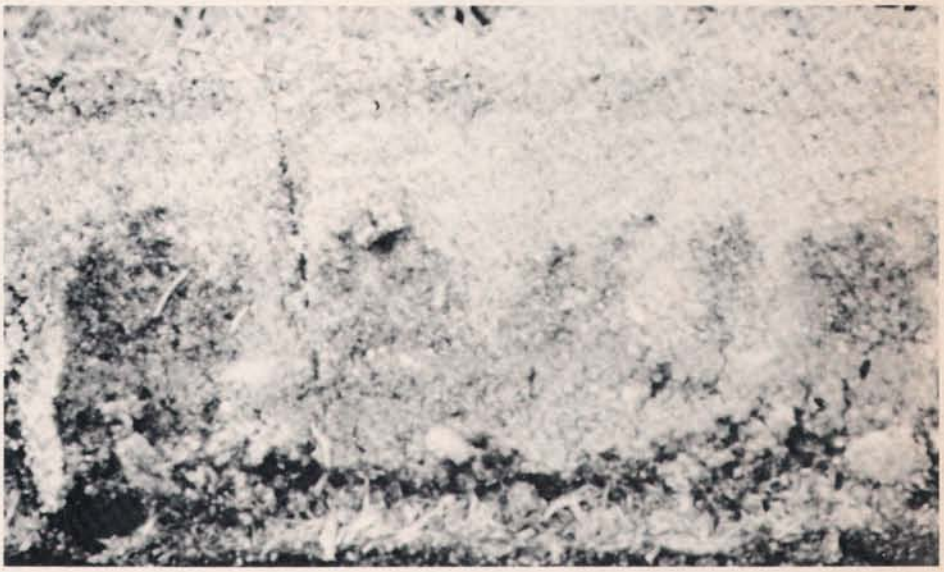
Furthermore, anaerobic micro-organisms in the soil can produce metabolites that are toxic to plants. These can cause either outright death of the roots or an unthrifty growth of the overall plant.

While this problem is receiving more attention than it did in times past, anaerobiosis of bentgrass greens is not new. For some 30 years, I have observed bentgrass putting greens in this condition in various stages of severity at a wide range of locations in this country. During the past year, I have diagnosed cases of acute anaerobiosis in plugs from putting greens with both predominantly sand and predominantly soil construction.

Turf managers should understand that sometimes a black layer accompanies anaerobiosis and sometimes it doesn't. The same is true for a strong odor of hydrogen sulfide or a high population of algae on the surface of the green.

The one thing all of these situations have in common is an anaerobic condition caused by water filling all of the soil's pore spaces. This water accumulation can be the result of prolonged periods of rainfall, or impaired infiltration brought on by either incorrect construction or an aerification program that included topdressing with an improper type of sand.

Anaerobiosis can be accelerated by an accumulation of algae on the surface of the green. Algae proliferate rapidly on greens with a high sand content. This is probably due to a number of facts.



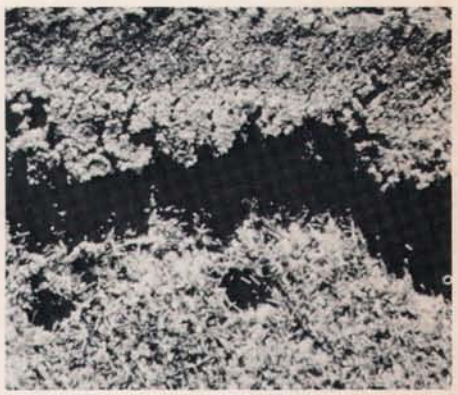
Black layer profile in old green topdressed with sand.

First, algae grow better on wet, light, sandy soils. Microbial competition is not as great as that found in mixes where soil is predominant. Irrigation practices on high-sand-content greens are often excessive. And finally, there is a wide "swing" in the availability of various nutrient elements in sand greens.

Algae produce complex carbohydrates (polysaccharides) that have the consistency of gelatin. This material can move downward into the soil profile, plugging the pores and impeding the infiltration of water. Not only do these polysaccharides contribute to the development of an anaerobic condition of the soil, but they also serve as a growth medium for anaerobic microorganisms. Algae, then, can be an important factor in the development of anaerobically induced decline of turfgrass.

An article in the June 1987 issue of *Golf Course Management* theorized that sulfur is the primary cause of anaerobiosis. The authors of these articles proposed that sulfur, not excess water, initiates an anaerobic state in the soil, and that sulfur (in the form of hydrogen sulfide) is the cause of plant death. Their premise centers primarily around the fact that sulfur does have the potential for developing a blackened condition in the soil. They were also able to produce black layers with very high rates of sulfur in their tests.

Their hypothesis assumed that sulfur at presently used rates will induce an anaerobic condition in the soil and produce black layers, and that all conditions of anaerobiosis in soils lead to the formation of black layers. None of these assumptions is correct. In fact, the results of their tests showed that sulfur applications within the normal range do not produce black layers.



Black layer profile in new green with sandy root zone mix.

The experimental design for this research consisted of applying sulfur at two separate rates, one pound and five pounds per 1,000 square feet. None of the experimental units treated with one pound of sulfur developed black layers, while 75 percent of those treated with five pounds did.

Where sulfur and products containing sulfur are concerned, there is no published scientific evidence that either elemental sulfur or sulfur contained in currently used turf fertilizers at recommended rates will cause

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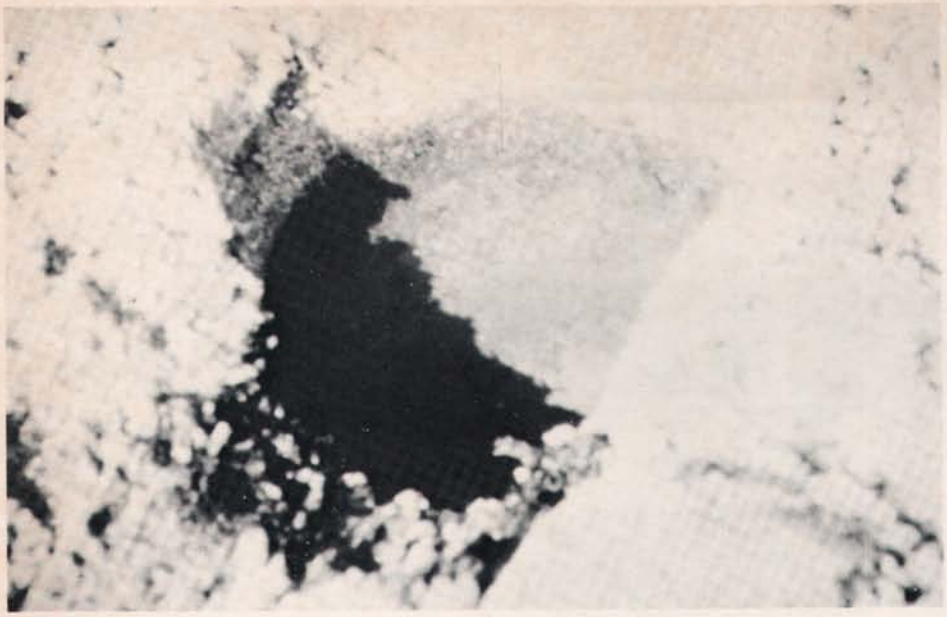

Black layer in sand bunker.

producing black layers.

Prevention of the problem is accomplished by close monitoring of the infiltration rates of the greens. When the rate begins to drop, even though it may not appear to be significant, direct measures should be taken to correct the matter.

When it has been determined that anaerobiosis has developed, steps should be taken to increase the oxygen levels in the root zone. This means following a watering program that allows the soil moisture to be extracted well below field capacity between irrigations. It means aerification—including deep aerification if drainage barriers exist. It may also call for installing supplementary drainage for the greens.

Another important aspect of preventing anaerobiosis from developing to the acute stage is the control of surface algae. At the present time, the only pesticide that can be used on putting greens for algae control is mancozeb (Manzate, Fore, Tersan LSR). This material is effective in the control of Helminthosporium-incited diseases, and is also effective in reducing the impact of Pythium blight. Its inclusion in the spray schedule can then serve more than one purpose.

Editor's Note: Dr. Houston B. Couch is professor of plant pathology at Virginia Polytechnic Institute and State University in Blacksburg, VA.

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or contribute to the development of anaerobiosis. This means that sulfur at the rates currently recommended will not *induce* anaerobiosis. . .and refraining from using sulfur will not *reduce* anaerobiosis.

The impact of anaerobiosis on plant growth can be either chronic (of long duration) or acute (sudden onset). It can exist in soil long before there is strong evidence of affected plant growth. It can exist without