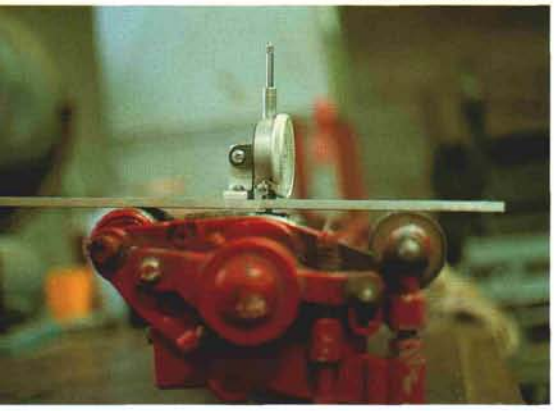
(Below) Establishing the mower clearance gap.

(Right) For uniform distribution, apply fertilizer at one-half rate in two directions.



Brushing or Dragmatting

These two management practices are used in place of verticutting. We usually use these during periods of hot weather to achieve basically the same results as verticutting with a lesser degree of stress on the turf. Double-mowing follows the process and leaves no evidence that the surface of the green has been groomed.

Combs or Brushes on Cutting Units

Personally, I have not used these on a routine basis. I feel using combs or brushes can continually change the surface, resulting in less than true putting quality. I put emphasis on specific management practices to achieve specific goals.

Turf Groomers

The recent development of turf groomers has captured my attention. This could be another fine tool to help produce a truer putting surface. The increased number of blades along with their smaller diameter will definitely do a much finer job as compared to conventional vertical mowers used today. Turf groomers can be an important key to producing fast greens that putt truer without the need to cut them so short. Time will tell.

New Ideas for 1987

This year we are trying two new ideas with our cutting units. First, in order to increase the frequency of cut with the Toro 21-inch walking mower, a 20-tooth chain sprocket was machined to replace the 16-tooth sprocket, which runs off the universal shaft. Secondly, on the Toro GM-300s, 11-bladed reels have been installed.

Our goal for this season is to produce a denser, smoother, healthier putting surface without cutting as short as in previous years. More precise mowing equipment and careful fertility practices may make this goal possible for all of us.

Managing Anaerobic Soils

by DR. ROY L. GOSS
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Editor's Note: In the following article, Dr. Roy L. Goss discusses the much-publicized black layer issue in a clear and forthright manner and from a position of experience and fundamental/basic agronomics. His original article appeared in the April, 1987, Northwest Turfgrass Topics.

AN ARTICLE entitled "The Black Plague" appeared in the November 1986 edition of *Golf Course Management*, and a similar article entitled "An Update on the Black Layer" appeared in the February 1987 edition of *Golf Course Management*. Unless I am badly mistaken and being misled from what I read, we all should be embarrassed to admit to the world that we have forgotten the fundamental concepts of managing soil and grasses. Isn't this problem of black layer or black plague simply one of an anaerobic condition developed through neglect of one or several management practices?

Soils in the coastal areas of northern California, Oregon, Washington, and British Columbia commonly develop anaerobic conditions between October and April of each year, unless they are properly managed. This time frame is characterized by heavy winter precipitation, low evaporation, low light intensity, and continued use of turfgrass facilities throughout the winter.

When soils become compacted, particularly under saturated or near-saturated conditions, the oxygen diffusion rate into these soils is near zero. Organic materials, which have accumulated in the surface few inches of these soils, may break down anaerobically, and many of their components are not oxidized, but are reduced. There have been comments from some writers alluding to the fact that sulfur applications are part of the problem. It should be common knowledge to these people that most of the soil's sulfur is held in reserve in organic matter. Regardless of whether we apply the material as elemental sulfur or if the plant gets it from breakdown of organic matter is irrelevant from the standpoint of oxidation and reduction. Under anaerobic conditions, sulfide ions are formed instead of sulfate ions, and one of the end products is hydrogen sulfide, which is a very foul-smelling substance. Usually, the resulting color is also black.

There isn't much question that under this total neglect of soil drainage and aeration, additional sulfur will cause problems. However, hydrogen sulfide can be produced without the addition of any elemental or extraneous sulfur applications. Sulfide ions can also interact with iron and other micronutrients to form insoluble sulfides. It is also common knowledge that most of these insoluble metal sulfides are usually black.

The reports from areas of the country affected by black plague indicate the soils are somewhat compacted, whether they be sands or heavier textured soils, wet, no roots on the turfgrass, and eventual death of both *Poa annua* and bentgrass on putting greens. It is generally conceded that *Poa annua* dies first, followed by bentgrass. It was also alluded to by some of these people that the condition was significantly improved following intensive aerification. I think now we are getting down to the real root of the problem.

MANY superintendents have been obsessed with developing the fastest greens in town, and the other superintendents have been forced to follow suit because their neighbors' greens were faster than theirs. The usual methods of developing fast greens are to 1) cut the grass as closely and as frequently as possible, including double and triple cutting, 2) verticutting, 3) elimination of aerification.

Reduction in irrigation water will also make the green surfaces firmer and increase ball speed. What do we do, however, when the surfaces are hard and compacted and excessive rainy periods occur? We should all remember that the respiration rate of turfgrass roots increases with increase in temperature. In the summer, when we get higher temperatures and rainfall, added to compacted soils, I think we are spelling doom unless we have extremely good drainage and good gaseous exchange with the soil.

The algae factor has also been mentioned. It is not at all uncommon to see thick algae scums that are slimy and slippery when wet, leathery and hard when dry, and literally impermeable to water or air. Algae usually follows thin turf and bare ground. These algal scums can definitely produce anaerobic conditions if the surface is not properly managed.

There was also comment about sand layering over slower draining, finer textured soils. To my knowledge, this condition has never been observed in the Pacific Northwest, where we probably have as long a history or longer than any other part of the country in sand topdressing putting greens, tees, fairways, sports fields, and other areas.

If you place one to four inches of sand through topdressing programs over slow-draining, fine-textured soils, you will achieve greater surface stability during most of the year, but it may not necessarily always be dry. Wet sand is generally considered to be more stable than wet fine-textured soil, since we can destroy the structure of normal soils containing silt and clay, and sands have no structure, since they are single grained. If anaerobic conditions develop at the interface between sand and heavier textured soil, it is obvious we need to improve our drainage situation. Since it is nearly impossible to drain deep, fine-textured soils on flat grades through artificial drainage techniques of drain tile, it is important that we try to practice subsoiling, deep aerification, or other methods of relieving the saturation, or simply build deeper profiles of sand. I would ask you, how else can it be done on a practical basis?

Tom Lubin wrote an article for *Divot News*, from the Southern California Golf Course Superintendents, a few months ago describing similar conditions in southern California, generally in August of each year. The symptoms on greens are yellow, especially the *Poa*. After a period of time, if not treated, the *Poa* will die, but the bent still has a healthy look. The root system is shortened, and there is a black or dark brown color to the soil, sometimes in bands. The soil samples have the smell of a stagnant pond. The symptoms do not respond to fungicide applications.

He also indicated that in areas of poor water quality or high salt content in the soil, salt levels were found to be high enough to cause severe problems, due to lack of drainage. We all know that good infiltration and permeability and good subsoil drainage are most essential to the reduction of salts to a level where plants can survive. Lubin also points out that good aerification and water management programs can shift the equilibrium to one of oxidation over reduction and create healthy conditions frequently as early as one week.

I hope this will help to clear up questions our readership may have in mind, and I would hope that turf managers remember to practice good management of soil aeration, compaction reduction, and good internal drainage to prevent these problems; there is no mystery here.