Soil and Its Maintenance for Turf Betterment

By TOM MASCARO

The finely divided (colloidal) particles in soil are able to hold plant foods which otherwise would be lost through leaching. Similarly, these very small particles have a "buffering" effect in the soil. When chemicals are applied to soil there is a margin for error because some of the material is taken up by the small particles thereby preventing damage to plants. The soil itself contains some plant foods, and it provides a medium in which micro-organisms, beneficial to plant growth, will grow.

Soil is a mixture of mineral and organic materials. The mineral portion is formed from rock which has undergone the processes of weathering for thousands and thousands of years. The effects of weathering produce physical and chemical changes in the soil material. Wind and water, heat and freezing break down rock into fine particles. Chemical changes also occur. Some soil materials take up oxygen (become oxidized), others take up water (become hydrated) and soil thus formed is different from that which merely has been broken down into smaller particles. Organic acids cause changes in the mineral portion of the soil too. Leaching has a considerable influence on the soil formed.

Soil formed from the same type parent material will be quite different under humid climatic conditions than under arid conditions. In dry regions soluble materials, such as calcium and sodium, remain in the soil. Their presence tends to make the soil alkaline. In humid regions these soluble elements are leached out and soil tends to become acid. Those are some of the chemical differences in soils.

Basis of Soils

The rocks which go into soil formation are familiar ones — sandstone, shale, quartz, hornblende and many others which are found today. The actual elements of which these rocks, and consequently soils, are composed include calcium, iron, silicon, aluminum, sodium, hydrogen and potassium, and many other commonly known elements.

Low forms of plant life grew in the mineral soil material, and as they died and decayed, they became the organic portion of the soil. There are, of course, deposits of peat which are entirely organic and will support plant life. But the best soil is a combination of organic and mineral material.

Soils as we find them today are not necessarily in the location where they were formed. Many soils have been transported to their present location. Some were carried there by wind, some by streams and rivers, others were deposited by streams from the ocean and some were moved by glaciers. These factors also have influenced the character of the soil. Most soils which are in the location where they were formed are coarse particles which were not easily carried by wind or water. Soils deposited by the ocean have been acted upon by the salt in the water. Wind-carried particles are of pretty much the same size; these wind-transported soils contain particles chiefly of the silt size.

The variation in particle size determines the soil texture. The particle size generally recognized are fine gravel, coarse sand, medium sand, fine sand, very fine sand, silt and clay. Separating soil into its different size particles is called mechanical analysis. Soils containing gravel and the coarser sand particles are coarse-textured soils. Mixtures of sand and silt make medium-textured soils, and a large percentage of clay makes a fine-textured soil. The coarse textured soils are well-drained; in fact, if there are too many coarse particles the soils may be too dry. The medium-textured soils are usually the most desirable. Fine-textured soils tend to become waterlogged and compacted.

Tell-Tale Clues of Soil

The texture of soil gives a clue as to how it will act. The color of the soil also gives the observer an inkling as to the character of the stuff. The organic matter content, the amount of weathering undergone by the mineral portion and the presence of iron give characteristic coloring to the soil. A deep brown or black color generally indicates that soil is well supplied with organic matter, decayed in the presence of adequate lime. In soils low in lime, organic matter decays in a manner which does not make the soil dark, so color cannot always be used as a guide to organic content. Also, if the

soil contains a large amount of dark-colored mineral particles, it will be dark even though deficient in organic matter.

A red color in the soil indicates the presence of iron oxide—which is the same as rust. When iron oxide takes up water (becomes hydrated) it gives the soil a yellowish color. In well-drained soils the reddish or yellowish color is visible even though organic matter is present. In poorly drained soils, the iron oxide loses oxygen (is reduced) and it then gives the soil a bluish color.

So the color of the soil can indicate the condition of drainage and amount of oxygen present. In other words, it gives a clue to soil structure. Texture refers to the size of the soil particles; structure refers to the arrangement of the soil particles. A sandy soil is made up of single grains. If a clayey soil is in a condition so the individual particles act as single grains, then there is not large enough pore space because the clay particles are so very small and fit too close together. It is desirable that the clay soil have a crumb structure—that is, the soil should be managed in such a way that many particles of clay or particles of clay and organic matter will group together and work as a single unit or crumb or granule—whatever you choose to call it. These larger granules have more space between them.

If soils do not have enough pore space, they become very compact and plant growth suffers from a lack of oxygen. In a dry soil the spaces between particles or granules are filled with air. But if soil becomes excessively wet, then all the pore space is filled with water and plant growth suffers. For good plant growth, the pore space should contain both air and moisture.

Pore Percentage Significant

For proper movement of air and water through the soil, a good percentage of fairly large pores is desirable. A poorly granulated clay soil contains many spaces between its numerous particles, but they are too small to permit proper circulation. A coarser-textured soil may contain a smaller quantity of spaces, but they will be of adequate size to permit passage of air and water.

Even though the texture of soil is such that there is a desirable number of moderately large pore spaces, this condition of good soil structure is not a permanent condition. Even in the case of agricultural crops, where soil can be plowed each year, the soil tends to become compact in the course of one growing season. Because of rainfall and settling of the soil, fine particles gradually fill up the pore spaces and soil becomes too tight for good growth.

Many areas planted in turf have been in use for years and years, without any operation being carried out to maintain the physical condition of the soil. Fertilizer and lime may be applied in an attempt to maintain proper chemical soil conditions. But these measures may be of little value when soil structure is neglected.

The physical condition of the soil definitely influences its chemical and biological activities. The most obvious situation, of course, is that plant roots grow where they can obtain air, water and plant foods. If soil is compact, these materials cannot penetrate very much beneath the surface and root growth is bound to be shallow. In some cases, thatched and matted conditions keep materials from even reaching the soil. Or, a layer of material of a texture different from the surface soil will interfere with circulation through the soil column and thereby stop root growth.

Oxygen is needed in order for roots to function properly and absorb food. Some plant nutrients are not available to the plant until they have been acted upon by soil microorganisms which need air to live. Physical soil condition is an important factor determining whether or not soil will be satisfactory for plant growth. It is essential to carry out a maintenance program which includes not only the maintenance of soil fertility by the addition of chemicals, but also maintenance of good physical characteristics. Mechanical methods such as aerification are the most economical way to maintain and improve physical soil conditions.

Proper aerification not only makes openings down through the turf so materials can penetrate, but also serves to loosen soil around the openings so materials can move laterally. Aerification breaks through layers beneath the surface and brings up soil to aid decomposition of an organic layer at the surface.

More and more, maintenance of turf areas is becoming recognized as a specialized job, and specialized equipment is needed to meet its requirements. Surface disturbance must be kept to a minimum, yet machine operation must be rapid enough and dependable enough to be practical. Cultivation should be deep and thorough—soil is most effectively loosened by the removal of soil cores. Discs and spikers were once the only implements available for soil improvement, but modern equipment offers many advantages over these methods.

Nature provided the soil—the all important mixture of mineral and organic particles. Probably you spend money and time applying materials to maintain and

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Class of 1949

Alexander Galanis, Present position not known
Lawrence Graham, Supt., Springfield CC, Mass.
William Kennedy, Asst. Supt., Grounds Department, Mass. Mutual Life Ins. Co., Springfield, Mass.
Norman B. Ladd, Asst. Supt., Racebrook CC, Conn.
Donald McKay, Jr., Supt., Avon Country Club, Conn.
Kayem Ovian, Supt., Wampanaug CC, Connecticut
Daniel Silvar, Supt., Oak Hill Country Club, Mass.
Bernard Simoneau, Supt., Amherst GC, Amherst, Mass.
Chester Wender, Asst. Supt., Montclair CC, New Jersey
Joseph Witazek, Turf Foreman, Mt. Auburn Cemetery, Mass.

Two year students are encouraged to take positions as assistant superintendents upon graduation. Due to demand in the last two years, most have become superintendents upon graduation.

Since many are sons of greenkeepers or have worked on golf courses before coming to the University, they have been quite capable of accepting the heavy responsibilities of a greenkeeping supt.

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improve the supply of plant foods in the soil. In order that plants can assimilate those plant foods and make maximum use of them, physical soil conditions must be right. Proper aerification is the way to ensure the loose, porous soil structure needed for optimum plant growth.

When to Aerify?

Quite naturally, the questions arise as to when to aerify and how often? Aerification should be carried out when soil is "right" for it—that is, soil should not be excessively wet nor should it be too dry and hard to cultivate. The same commonsense that tells a person when to spade up the garden is a good guide as to when it is alright to aerify. As to frequency—the oftener the better. Aerification preferably should be done more than once at each operation and the operation should be carried out more than once each season.

An increasing number of superintendents favor once a month aerification throughout the growing season. Improvements on aerifying equipment, to reduce

surface disturbance, make such a program practical. Thorough watering should immediately follow aerification in dry weather. On fairways if it is not possible to apply artificial water, then obviously these areas cannot be aerified regularly during dry weather. However, such areas should be aerified several times in the spring while natural moisture conditions will permit it.

In regions where frost lifts the grass, rolling should be done after aerifying in the spring. Later this may not be necessary. The aerified surface can be made playable simply by distributing soil with a bamboo pole, followed by mowing. On areas too large for poling, a dragmat, followed by mowing—or just mowing alone—will leave the surface in good condition.

These same general considerations apply when aerification is a part of the fall renovation program. However, when aerification is done to prepare a seedbed in existing turf, one or two aerifications should be deep to promote root growth, and this should be followed by several shallow aerifications to prepare the surface thoroughly so seed can come in contact with soil.

Aerification in the late fall and even on into the winter months, when soil conditions permit, is being done at many golf courses.