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SOIL FUNDAMENTALS OF TURFGRASS GROWTH

Soil isn't just so much dirt. It is a mixture of a solid, a liquid and a gas, ideally containing by volume 50% solids, 25% moisture and 25% air. As the home for turfgrass roots, which in turn are primarily responsible for the condition of the tops that our golfers play on, it should be treated with the respect a contractor gives the foundation of a new building he is constructing.

A healthy soil is a constantly changing dynamic medium. It is not an inert, lifeless, static thing...it is alive, teeming and full of activity. Numerically there is more animal and plant life in a spoonful of healthy soil than the world's entire human population. A single spoonful may contain upwards of a quarter of a trillion bacteria. In terms of turf culture a living soil means better utilization of fertilizer and moisture, and thus, a healthier, more economically maintained surface for golfer enjoyment.

To properly appreciate the importance of our "Soil Bank", and to prevent bankruptcy in the form of dead grass where dense vigorous turf should be, it is necessary to understand a soil's physical condition, microbiology and chemistry as it affects inherent fertility and water and air movement. The subject will be covered in this and the May-June issue of your Western Turfletter.

Soil Physics

All soils have their beginning with the accumulation or exposure of finely divided, weathered rock materials. The introduction of living organisms starts the true soil-forming process, and the variety of soil classes found is dependent upon natural forces that are building up, changing, or destroying the original parent material. Since these forces are not uniform over the earth's surface, soils differ in texture, structure, depth and color.

Although minerals make up over 90% of the dry weight of soils, by volume they occupy only 50% to 60%, the rest being organic matter, water and air. It is the arrangement of these minerals, structure - and their size, texture - that is responsible for a soil's productivity and classification, respectively.

A deep uniform medium sandy loam texture containing about 20% organic matter with a wide range of particle size from coarse sand to fine microscopic clay is ideal for turf growth. The organic matter and clay are strong cementing agents to provide good structure which is responsible for the small water-holding porosity and inherent fertility. High sand content, with a gradation of particle size, is responsible for large drainage and aeration porosity, and has a further advantage in providing a desirable braking action on approach shots even when the soil is dry.

Such a soil seldom is available locally but can and should be artificially constructed for topdressing and initial planting of putting greens. Where its structure is maintained by good management and subdrainage is good, it will hold sufficient moisture for plant growth, permit rapid removal of excess water after irrigation or rain, and permit leaching of salts where water quality is poor.

Soil Microbiology

To quote Dr. Richer, Pennsylvania State University: "Without soil there is no life; without life there is no soil and the mighty microbe is the life of the soil". Microbes have the ability to use the stored energy of the sun, i.e., organic matter, in their own growth processes. In breaking down organic matter the mighty microbes release nitrogen, phosphorous, potash and other elements necessary for plant growth. Even ammonium sulfate must be broken down into a nitrate form by microbes before it becomes available to our turfgrasses. During the breakdown process large quantities of carbon dioxide are liberated to form mild carbonic acid in the presence of water. This acts to liberate nutrients of the soil minerals that otherwise would be unavailable for turf growth. Carbon dioxide is responsible for human life. Without it, the three-hundredths of one per cent in the atmosphere would be exhausted in 35 years, plants would die and human life would soon join them to end our worries of brown areas where green turf should be.

Not all microbes are beneficial to turf growth, as witness turf diseases caused by fungi, and anaerobic (lack of air) conditions in water-logged soils where anaerobic microbes cause loss of nitrogen as a gas and other toxic substances like reduced manganese, iron, sulfite, nitrite and methane gas to kill our living plants. The damage caused by these harmful microbes can be offset by making conditions favorable for the beneficial aerobic microbes. It is for this reason that we stress the importance of good physical soil texture and structure with ample large porosity to prevent water-logged conditions. It should also indicate what might have caused the turf to go out during that hot, muggy spell last summer when demands for oxygen were at their highest by the turf as well as the mighty microbes.

Soil Chemistry

There are few people associated with turf management who are not aware of the importance of nitrogen in stimulating vigorous growth. However, many may fail to realize that over a dozen other elements are essential, and that sulfur, as an example, is required

in as great a quantity as phosphorous. Many of the necessary elements are already present in the soil or are applied as an extra dividend with the fertilizer materials used. Thus, past emphasis has been rightly placed on the big three of essential elements - nitrogen, phosphorous and potash. Where the soil is neutral to slightly acid with adequate reserves of calcium and magnesium, the proper feeding balance of the big three usually is sufficient to promote healthy growth. The proper balance is extremely important, especially on putting greens, where in the words of Dr. Noer, Agronomist, Milwaukee Sewerage Commission, "The Golf Course Superintendent is a true farmer since he is continually harvesting and removing a crop".

Considerably more emphasis needs to be placed on this matter of a balanced diet for putting green turf. For years our Western Research Stations have not recommended the use of potash in agriculture because most western soils in their virgin state are inherently rich in this element. However, even for agricultural crops this picture is changing. Dr. Chapman, Soils Department, University of California, Riverside, reports in the February 1955 Better Crops With Plant Food, that there is a net loss of 236 pounds of potash per acre annually in California soils. Under putting greens the loss is even greater because we harvest a crop three or more times a week for 52 weeks each year in some sections of the west. Several Western Clubs have found that nitrogen and phosphorous are not enough, and that some potash should be added each year if the turf is to be wear-resistant and fungicides give proper disease control.

Many clubs have gone to the other extreme in balancing the diet by continuous use of complete commercial fertilizers that apply far more phosphorous than the grass can possibly use. This is wasteful, expensive and responsible for poor crabgrass and annual bluegrass control with lead arsenate. It further can intensify nutritional disorders like iron chlorosis. It should be remembered that most complete fertilizers were formulated to encourage the production of fruit or flower where high phosphorous levels are important. In turf we are interested in vegetative not seed production.

In a now classical 1944 experiment carried on by the Milwaukee Sewerage Commission in cooperation with Brynwood Country Club in Milwaukee, the laboratory analysis of collected and weighed clippings showed each 1,000 square feet of putting green produced approximately 100 pounds of dry grass for the 6 month season. The clippings contained 4.83 pounds of nitrogen, 1.80 pounds of phosphoric acid and 3.24 pounds of potash. This 5-2-4 ratio is a far cry from the commonly available 5-10-5, 6-10-4 fertilizers sold in the west. Thus, it is small wonder that proper soil analysis shows many of our putting green soils are becoming low-grade phosphate mines.

To know what our "Soil Chemistry Bank" contains it is necessary to make periodic soil tests for phosphorous, potash, calcium and magnesium, and the test is worthless unless samples are properly taken and the results are properly interpreted. In a future issue we will discuss proper sampling methods and analysis of the results.

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