Soil as a Medium for Growth and a Source of Plant Food

THE soil framework consists of mineral particles derived from the disintegration of rocks (excepting peat and muck). In a productive soil, water films charged with carbonic acid and small quantities of soluble nutrients surround the soil granules; the intervening voids are occupied by air. By volume, a cubic foot of fertile soil contains about 50% solid matter, 25% moisture, and 25% air. Approximately 85% of the solid mass is mineral and 15% is organic.

The extensive system of grass roots which permeates the soil, absorbs moisture and dissolved nutrients from the water films. The myriad of root cells all breathe and obtain the necessary oxygen from the soil air. During respiration carbon dioxide is expelled, some of which dissolves in the soil water. The resulting carbonic acid exerts a definite solvent action and thus aids in the solution of insoluble soil minerals.

Grass roots rarely extend below the surface few inches, so that portion of the soil deserves major attention. Yet subsoil may indirectly affect the water and air relationship of the surface soil. If the subsoil is too heavy, it prevents or retards downward movement of surplus water, and, if coarse, unduly accelerates percolation so the soil dries out too rapidly.

SURFACE SOIL FACTORS: There is a distinction between the surface soil, to a depth of 6 to 8 inches, and the underlying subsoil. Humus, or organic matter, is the distinguishing characteristic of the surface soil. Because microscopic soil organisms obtain their energy requirements from organic matter, they are most abundant in the surface soil, and their numbers are roughly proportional to the amount of decomposable organic matter. These ceaseless workers play an important part in the conversion of organic nitrogen, and difficultly soluble nutrient materials, into forms which the growing plant can utilize. Due to their activity and the play of inter-related chemical forces, soil undergoes constant change. In this respect it is never static, but constantly dynamic; hence soil is more than just so much dirt.

Since the soil must furnish a continuous and adequate supply of water, mineral plant food elements, and oxygen, it is apparent that a favorable soil environment is absolutely essential for the performance of these multiple functions. Some of these deserve detailed treatment.

FAVORABLE PHYSICAL SOIL CONDITIONS: Failure to provide suitable soil from the physical standpoint is responsible for many turf failures, especially in shady locations and on areas subject to excessive wear. The logical time to modify the soil is before seeding, for turf is a permanent crop.

The size and arrangement of the individual soil particles determine physical condition. Together they affect water-holding capacity and amount of air space; determine rate at which water passes down through the soil; and the influence capacity to supply available soil nutrients.

The term texture refers to the size of the mineral grains. Soils may be coarse, medium, or fine textured, depending upon the predominating or important soil particles. Sand is the main constituent in coarse soils, but clay is most important in those of fine texture.

Soil particles are grouped into three main classes designated as sand, silt, and clay, but sand is further subdivided into fine gravel, coarse, medium, fine, and very fine sand. Each of these seven classes is called a "soil separate", because soil is a mixture of the various sized particles. The limits in size for each separate depend upon the relative value of the various particles in affecting the physical properties, and the producing power of the soil. Silt and clay are exceedingly small as compared to sand. The immense difference is seldom appreciated. In one gram (454 grams equal 1 pound) there are only 2,000 coarse sand grains, but the staggering total of 45 billion clay particles. Is it little wonder that slight variations in texture often exert profound differences in soil properties?

BASIS OF SOIL CLASSIFICATION: Since soil is a mixture of various soil separates, the relative amounts of sand, silt, and clay serve as a basis of classification. In a sand soil, sand particles predominate; loams consists of a mixture in which none of the separates predominates; silt is the main constituent in silt loam; and clay is the important separate in clay loam and clay soils. The proportion of clay is not necessarily larger than other fractions; because a given amount of clay exerts a greater modifying effect than the same amount of sand.

The A B C of TURF CULTURE

Based on texture, soils are grouped into the following classes: sand, sandy loam, loam, silt loam, clay loam, and clay. Sand and sandy loam may be coarse, medium, fine, or very fine, depending upon the size of the predominating sand separate.

With experience it is easy to place a soil in its proper class by simple inspection in the field. Texture is judged by rubbing moist soil between the thumb and forefinger. Sands are recognized by their lack of coherence; sandy loams contain large amounts of sand, but have definite cohesiveness due to the presence of some silt and clay. Loams have a gritty feel due to the presence of sand, but have distinct cohesive properties due to the larger content of silt and clay. Silt loams have a smooth, floury feel, and differ from the clays by the absence of a slick, shiny surface when quickly rubbed as suggested.

All things considered, the medium sandy loams and loams approach the ideal for turf production, especially if they contain organic matter. They possess sufficient coarse particles to facilitate downward removal of surplus water, yet have enough clay and silt to provide adequate water-holding capacity.

Necessary changes in soil texture should be made prior to seeding, for this is the only time that supplementary sand, clay, or organic matter can be incorporated into the soil. Very little clay or heavy soil is needed to completely change the physical characteristics of a sand, but large quantities of sand are required to appreciably change a heavy soil. The use of uniform textured fine sands should be avoided for they tend to pack and cement the soil. Better results will be obtained with sand consisting of various sized particles.

On areas already in grass, applications of pure sand, peat, or clay produce pronounced layers which invariably cause trouble in hot weather by seriously interfering with free movement of soil water. Frequent light topdressing with a soil mixture of proper texture is the only safe procedure. This eventually builds a desirable surface soil.

SUPPLY OF ORGANIC MATTER: The difficulty experienced in attempts at turf growth on areas from which the surface soil has been stripped is due to the absence of organic matter in the exposed subsoil. Such areas are said to be dead, because lack of organic matter prevents the existence of essential soil micro-organisms.

From the standpoint of turf management the effect of organic matter on soil structure is most important. It tends to lighten heavy soils, and by binding sand grains, effects marked improvement in sandy soils. Although organic matter has an enormous water-holding capacity, this fact is often over-emphasized.

In building greens, or in the preparation of topdressing, it is often impossible to prepare soil of suitable texture by the use of soil and sand only. Any combination produces a mixture which tends to consolidate. This can be overcome by supplementing the soil-sand mixture with suitable organic material. Where manure is not available peat can be substituted, but should not constitute more than one-third by volume of the final mixture.

Logically, needed organic matter should be introduced prior to seeding. On greens and other areas of limited size, this can be accomplished by the liberal use of manure or other humus materials, such as peat moss, reed or sedge peat.

WHEN TO USE SUPPLEMENTARY FERTILIZERS: Where humus substitutes replace manure, supplementary fertilizer should be used because peat does not supply appreciable quantities of plant food. In fact somewhat more generous use of nitrogen is warranted, because more abundant development of cellulose decomposing organisms tends to deplete the supply of soluble nitrogen and thus deprives grass of needed food.

If time permits, green manure crops can be used on fairways and other large areas. Legumes because of their nitrogen-gathering power are preferred crops. Soy beans are an excellent crop for northern latitudes and should be seeded around Decoration Day. They can be plowed under in early August. Sudan grass seeded with the soy bean increases the amount of organic matter and is desirable because of its more complete root penetration. Although not a legume, rye is excellent for fall seeding, and growth continues in the spring. The soy bean-sudan grass combination can follow this crop.

Soil for topdressing mixtures can be prepared by this same procedure, except that green manure cropping should extend over a period of several years.

(To be continued)

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