SEPTEMBER
1933
VOLUME VII
NUMBER 9

The NATIONAL GREENKEEPER and TURF CULTURE

The only trade journal in the world devoted to the growing of fine turf grasses.

Physical Properties of Soils and Their Relation to Turf Maintenance

By O. J. NOER

SOILS may be divided into two groups depending upon the predominance of organic or mineral matter. Except in extreme northern latitudes organic soils are of limited occurrence, being formed where excess moisture retards or prevents the decay of plant residues. They are classed as peats or mucks, depending upon the extent of decay.

O. J. NOER

Who has tramped the soils of the United States and Canada until he knows them all by their first names.

PEATS: Wherever moisture conditions are especially unfavorable for decomposition of the original vegetation, peats are formed, so they represent the first stage of decay. Peats are usually brown in color, almost devoid of mineral matter, and have a fibrous structure from the preponderance of partially decayed plant structures. It is usually possible to identify the type of plants from which it was derived. Drainage and cultivation frequently accelerate decomposition, and eventually they then become mucks.

MUCKS: When more complete decay of plant structures takes place mucks are formed and they are also essentially organic soils. Mucks are usually black in color, and plant structures as such are not discernible, and are considered more productive than peats.

MINERAL SOILS: It is upon these soils that turf grasses are commonly grown. They are primarily a mixture of mineral particles derived from the disintegration of rock, but the surface soil layer also contains humus resulting from the decay of plant and animal residues. The subsoil usually contains a larger proportion of fine particles and as a consequence is more compact.

The roots of turf grasses rarely extend beyond the surface a few inches so the character of the surface soil is most important. The subsoil does, however, indirectly affect the water and air relationships of the surface soil. If too heavy it retards or prevents downward movement of excess water, and of course unduly accelerates percolation and then the surface soil dries out rapidly.

A cubic foot of ideal surface soil contains about fifty per cent solid material, twenty-five per cent moisture and twenty-five per cent air. Approximately eighty-five per cent of the solid portion consists of mineral particles and fifteen per cent is humus.

IMPORTANCE OF PHYSICAL SOIL CONDITION

THE size and arrangement of the individual soil particles determines physical condition. Together they affect the amount of air space, water-holding capacity, rate at which water passes down through the soil, and influences its capacity to supply soluble plant food elements.

Neglect to provide suitable soil from the physical standpoint is responsible for many turf failures, particularly on areas subject to excessive wear and traffic. Unfortunately it is almost impossible to quickly and markedly change a soil after turf is once established, and until modified it is difficult in extreme cases to effect turf improvement by fertilization or other particles.

TEXTURE DENOTES SIZE OF SOIL PARTICLES

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

The three main groups of soil particles are sand, silt and clay, but sand is further subdivided into fine gravel, coarse, medium, fine and very fine sand. Soils are a mixture of various sized particles so each of the seven classes is called a soil separate. The limits in size for each separate depend upon the relative values of various sized particles in affecting the physical properties and in turn the producing power of the soil. Each of the seven classes includes all particles whose diameter fall within the limits outlined in the accompanying table.

LIMIT OF SIZE

	Millimeters	*Inches*
Fine Gravel	1.0 -2.0	.039 -.078
Coarse Sand	0.5 -1.0	.019 -.039
Medium Sand	.25 -0.5	.01 -.019
Fine Sand	0.1 - .25	.004 -.01
Very Fine Sand	.05 -0.1	.002 -.004
Silt	.005-.05	.0002-.002
Clay	Less than .005	Less than .0002

The immense difference in size between coarse sand and clay is rarely appreciated. Only twenty-five coarse sand particles placed side by side span an inch, whereas it takes five thousand of the largest clay particles to bridge the same distance. These differences account for the tremendous numbers of fine particles in a given volume. In one gram (453.69 grams equal 1 pound), there are only two thousand coarse sand grains, but almost sixty-five million silt particles and the staggering total of forty-five billion clay particles. With these enormous differences there is little wonder that variations in texture exert profound differences in soil properties. Some of the distinctive properties of sand, silt and clay deserve special mention.

SAND: Most sands consist essentially of quartz grains. Pure quarts is opaque and hence easily recognized. Occasionally sand grains are colored either by impurities dispersed within the particle or as a thin film covering the surface. Most of the white silica sands contain more than ninety-nine per cent quartz. Due to the abundance of quartz, sands are usually low in plant food elements. Other minerals may be present especially in the finer-grained sands and these usually contain more of the essential plant food elements.

The chief physical characteristic of sand is its lack of coherence or ability to retain its form especially when dry. This is most pronounced with the coarser sands. Its lack of coherence keeps the soil open and friable, but in excess may seriously interfere with the water-holding capacity by accentuating losses by drainage and evaporation. As the proportion of coarse sand increases, the soil becomes less suited to cultivation until finally the condition is reached where crop production is impossible except in situations of unusual moisture.

The fine sands have some power to hold moisture and certain degree of cohesiveness. In fact, after rains, soils containing in the neighborhood of fifty per cent fine sand tend to form a hard crust on the surface through which young plants make their way with difficulty. Where sand is used to ameliorate heavy soils it must be coarse and sharp and used generously. Fine and very fine sand are not suitable because they tend to form hard crusts.

SILT: Most fertile soils of the upper Mississippi valley are rich in silt, containing fifty-five or more per cent of this separate. Locally they are called clay soils but are actually silt loams. Silt probably plays an important part in maintaining uniform conditions of moisture so essential to plant growth. It is sufficiently fine to retard but not prevent percolation and facilitates capillary movement within the soil.

Clay belongs to a class of substances called colloids, a term applied to substances in a very minute state of division. Colloids when placed in water remain in suspension and the liquid usually becomes turbid or cloudy because the particles do not dissolve to form a true solution.. Many of the distinctive properties of clay are due to its colloidal nature.

When clay is moistened it swells slightly and can be molded into shapes which are retained. On drying, shrinkage occurs and the mass becomes very hard and tenacious. During periods of dry weather shrinkage causes cracks to develop in clay soils. Alternate wetting and drying tends to improve physical soil conditions by the operation of these forces. If worked when wet clay becomes puddled, the individual particles are separated and packed so closely together that even thin layers prevent the free movement of water.

CLAY IS TOUGH TO HANDLE

WATER soon becomes turbid when clay is agitated with it, and even after long standing the minute clay particles still remain in suspension. The addition of small amounts of certain substances such as lime, gypsum, calcium nitrate, etc., cause the suspended particles to clot and form larger aggregates which rapidly settle to the bottom and the water becomes clear. When these aggregates are formed the clay is said to be flocculated. This power of clay to flocculate or form aggregates occurs in the soil mass and plays an important role in the management of soils high in clay. When the clay is in a state of aggregation the soil behaves as though it were composed of coarser particles. Some substances such as potassium, sodium, ammonium carbonate, etc., prevent the formation of compound granules and tend to destroy existing aggregates. They are said to deflocculate the clay and are called deflocculating agents.

The detrimental effects following the continuous use of sodium nitrate on clay soils results from the formation of so-called sodium clay which remains deflocculated. Even the repeated use of sulphate of ammonia or any other fertilizer which creates an acid soil tends to produce bad physical condition because acid clay does not easily form aggregates. Additions of lime usually correct the condition by converting both these clays to so-called calcium clay which flocculates readily.

The disasterous effects produced by working clay soils when too wet are not easily corrected. Just as the potter works clay to break the aggregates into the ultimate particles and make it more plastic, so working clay soils when too wet destroys the aggregates and makes the soil more clayey than before. Then the soil is more impervious to the passage of water and air, and dries into hard, tenacious lumps. To make it tractable again is difficult and requires time. It is accomplished by the action of weather such as freezing and thawing and alternate wetting and drying. The incorporation of organic matter is helpful, and the action of lime particularly effective.

TEXTURE USED AS BASIS FOR CLASSIFYING SOILS

MINERAL soils consist of a mixture of the different soil separates, and the relative amounts of sand, silt and clay are used as a basis of classification. In a sandy soil, sand particles predominate, and the larger the proportion the sandier the soil. Loams usually consist of a mixture in which none of the separates predominate. A clay soil contains a large proportion, but not necessarily a larger amount of clay than material of any other size, because a given amount of clay exerts a greater effect upon the properties of the soil than the same amount of sand.

Confusion sometimes arises from the dual significance of the terms sand, silt, and clay. They are used to designate soil separates and also soil classes. When applied to a soil separate they define the size of the soil particle, and with the soil class they distinguish the fraction which contributes most to the soils' properties.

For practical purposes soils are grouped into the following classes based on texture:

Sands (usually poor turf soils).

Twenty per cent or less silt and clay; eighty per cent or more sand depending upon the predominating sand separate. They are coarse, medium, fine or very fine sand.

Loams (generally good turf soils).

Sandy Loam—20-50 per cent clay and silt, 50-80 per cent sand.

Loam 20 per cent or less clay; 50 per cent or less silt, balance sand.

Silt Loam—20 per cent or less clay; 50 per cent or more silt; balance sand.

Clay Soils (good but require careful management).

Clay Loam—20-30 per cent clay; 50 per cent or less silt, balance sand.

Clay—30 per cent or more clay; balance silt and sand.

With a little 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 first finger. Sands are recognized by their lack of coherence. The sandy loams have large amounts of sand but possess some cohesiveness due to the presence of some silt and clay. Most difficulty arises in distinguishing between the loams, silt loams and clays. Silt loams have a floury feel, are almost devoid of gritty sand, and differ from clay by the absence of a slick, shiny surface when quickly rubbed between the thumb and forefinger. The presence of larger amounts of gritty sand usually serves to distinguish loam from silt loam.

ARRANGEMENT OF PARTICLES DETERMINES SOIL STRUCTURE

NEXT to texture, the arrangement of the soil grains is of great importance, for it influences the circulation of air and water, both of which are necessary to the normal development of turf. In a clean sand each particle is an individual unit and has but a chance arrangement in relation to the adjacent grains. Fertile soils possess marked structure. The individual grains are bunched and more or less bound into groups, usually spoken of as granules or crumbs.

Soil colloids are the principle cementing agent. The loams form crumbs readily, but in heavy clays the colloidal properties are so pronounced that the soil becomes sticky and impervious when wet and form hard clods on drying. Flocculation of the colloidal clay facilitates granulation while clay in the deflocculated condition has the opposite effect.

The word tilth is used to designate physical soil condition. A well granulated soil is referred to as in good tilth, whereas a sticky, lumpy soil is said to be in bad tilth.

The development of crumb structure is necessary in all soils, but is most essential in soils of fine texture, silt loams, clay loams and clays. The formation of compound granules permits these soils to function as though more or less coarse-grained. Obviously granulation promotes freer movement of water and air, and permits ready penetration of roots and root hairs. Without it the spaces between the particles may be so small that the soil is almost impervious to water.

A coarse, sandy soil usually disposes of excess water by percolation after a heavy rain within a couple of hours, but the finest clay without granular structure may require three months to free itself of a like amount of water in the same way. When the fine clay particles are held as constituents of larger aggregate grains, excess water passes down through the soil quickly. Furthermore the compound granules act like tiny sponges, being charged with water and plant food elements which can be absorbed by the advancing root hairs.

(More next month)

Overcoming Cricket Moles

By HUGH C. MOORE, *Greenkeeper*
Sea Island Golf Club, New Brunswick, Ga.

FOR the past three summers I have been troubled very much by Porto Rican cricket moles and early this spring my fairways and tees were damaged very bad, in fact it had gotten to the point where something had to be done.

I suggested that we use arsenate of lead which I had previously suggested a year ago, after experimenting with same on a small plot. I have this past spring poisoned all my fairways and tees using one hundred and fifty pounds per acre where they were not so bad and two hundred pounds in more troubled places. The results from this poison has been most surprising. The turf has thickened up and once more the players seem to be happy.

In putting on this poison I bought a fertilizer spreader from the Holden Co., Inc. This machine fits on the back of a thirty-six inch wagon. I tried mixing this poison with topsoil, also with sand, but found that the raw material worked much better, picking calm days to keep same from blowing. Arsenate of lead does not kill the mole but the poison gets into the joints of the grass which the cricket mole survives on and as long as the flavor of the poison remains the mole will stay away.

It is almost impossible to kill this pest as they can fly and any poison that will kill the mole will kill the grass. Any greenkeeper that is troubled with this pest can take my word that arsenate of lead is the thing. This method is somewhat expensive but well worth doing.

Detroit Lakes, Minnesota

Assistant Attorney General A. D. Brattland, representing the Conservation Commission, recently started condemnation proceedings to acquire an additional 960 acres of land adjoining Itasca Park on the east and thus preserve for posterity more of this beautiful and primitive wilderness—the last remaining in Minnesota.