

Physical Properties of Soils and Their Relation to Turf Maintenance

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SOIL is a porous mass and the space existing between the solid particles usually called the pore space is occupied by air and water. The amount of pore space is a function of the size and arrangement of the soil particles.

Theoretically in a soil made up of equal-sized spheres in contact with one another the amount of pore space depends solely upon their arrangement. Thus a cubic foot of marbles contains as much pore space as one of small shot with the same arrangement of spheres. If the spheres are grouped in the most open fashion forty-seven per cent of the total volume is pore space, and if arranged as close as possible it drops to twenty-six per cent.

With compound spheres, that is small spheres within the larger spheres, which is the condition in well granulated soils the pore space may approach seventy-five per cent. By taking three-sized spheres and using the closest method of packing, the pore space reduces to five per cent. This is the condition existing in puddled clays. Working these soils when too wet forces the small particles into the spaces between the larger ones and the pore space then becomes negligible.

Soil grains are never true spheres, they are irregular in shape and uneven in size, so the ideal arrangements cited above do not obtain. Ordinarily in fine-textured soils the small particles are so light that they do not settle as close together in proportion to their size as do the sands. The relation between texture and total amount of pore space for some soils under field conditions is as follows:



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

*Per Cent
Pore Space*

Clean Sand	33.50
Fine Sand	44.00
Sandy Loam	50.00
Silt Loam	53.00
Clay	56.00

Not only the total amount of pore space, but the diameter of the individual pores is of importance. Together they determine the capacity of the soil to retain and move air and water, as well as to facilitate the extension of plant roots. These conditions are usually found in the sandy loams and loams.

PHYSICAL SOIL CONDITION BEST SUITED TO TURF

IDEAL soil conditions are most likely to occur in the loam soils. These soils have some particles large

enough to function separately, and others of medium size to form centers around which the smaller particles may cluster to form granules or crumbs. This provides a few large pore spaces which facilitate drainage and root movement, and numberless small openings with the compound granules charged with water and plant food awaiting the coming root hairs.

HOW SOIL TEXTURE AND STRUCTURE CAN BE MODIFIED

THE only feasible method of changing soil texture is to add material of different texture. Obviously the huge expense prohibits such practice on extensive areas such as fairways, parks, etc., but it is entirely feasible in the preparation of soil for golf greens and small lawns.

A common mistake is to use too little sand on heavy soils. The presence of only thirty per cent clay in a soil is sufficient to classify it as a clay, the balance may be all sand. If ten per cent of the clay in the above soil could be replaced with sand making the clay content twenty per cent and the sand eighty the soil would become a sand. Thus only ten per cent difference in clay content changes the soil from one extreme to the other. Hence, relatively small amounts of clay suffice to effectively change sands, but large amounts of sand are required to materially modify the properties of heavy soil.

It is important to provide soil of as near ideal texture as possible prior to seeding. Failure to do so may retard or prevent formation of dense heavy turf, and after turf is even partially established it is not easy to modify soil texture. Applications of pure sand, clay or humus do not mix well with the underlying soil and thus may do positive damage. Changes must be effected by gradually building a soil of good texture by frequent applications of suitable topdressing material.

SANDY LOAMS AND LOAMS MOST SUITABLE
FOR golf greens soils of intermediate texture, the sandy loams and loams are certainly most suitable. These require minimum additions of humus or sand. Too much humus makes them spongy and may unduly encourage worms. If the clay content is too high the soil consolidates and the surface of the green becomes hard. Rolling and traffic of players aggravates the condition and the green eventually becomes "hide bound."

Players complain that greens will not hold the ball. Heavy watering to soften the soil is a makeshift remedy and may do positive injury to the turf by filling the pore spaces, thus depriving the roots of needed oxygen. In extreme cases greens should be forked, followed by topdressing with material of proper texture. Permanent improvement must come from the use of suitable topdressing material

and gradually building up a layer of good soil. If soil texture is right there should be no complaint about the ability to hold the ball.

ADEQUATE DRAINAGE IS FIRST ESSENTIAL

ON EXTENSIVE areas, improvement of soil structure must be the aim rather than extensive changes in texture. Development of granular structure on heavy soils produces marked improvement. Adequate drainage is the first essential. When these soils are saturated with water, the excess water tends to break down and detach the small particles held in the compound granules. Thorough drainage removes this superfluous water, and as the water films surrounding the particles contract the small particles are gathered into clusters and lightly cemented by the action of humus or the salts dissolved in the soil water.

During the winter, freezing and thawing promote granulation. Too early and heavy rolling when the soil is very wet may puddle the soil. Rolling beyond that necessary to force heaved turf back is dangerous on heavy soil. If the turf is poor it should be encouraged by judicious feeding. The extension of roots and the augmentation of the humus supply when the old roots die will improve soil condition. Surface applications of manure do not add much humus to the soil, after turf is established.

When new seedings are contemplated on fairways or other large areas, extreme care should be exercised in the preparation of the seed bed if the soil is fine textured. Plowing should be done when the moisture condition is such as to prevent puddling and formation of clods. While rarely possible, plowing a season in advance of seeding improves granulation resulting from alternate freezing and thawing during the winter. Generous applications of manure applied and disced into the soil after plowing will help lighten the soil. If it is possible to grow a green manure crop and plow it under the resulting humus will prove beneficial.

