Golfdom
The Business Journal of Golf
REG. U. S. PATENT OFFICE

VOL. 4 JUNE, 1930 NO. 6

Describes Soil's Part in Turf Maintenance

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GOLF courses rarely possess soil which is ideally adapted to the growth of turf grasses. Other factors carry more weight in the selection of prospective sites than suitability of soil. Yet the soil is the foundation upon which the grasses develop.

Except on some of the very sandy soils, it is seldom necessary or feasible to attempt profound modification on fairways. With favorable weather conditions, rapid establishment of desirable turf depends upon careful soil preparation, proper fertilization and selection of grass varieties adapted to local soil and climatic conditions. Improvement of poor turf on old established fairways is usually a matter of supplying plant food deficiencies, accompanied by some re-seeding, where the turf is unusually thin.

Greens are the backbone of any course, and are always the subject of comment by golfers. An unfavorable soil environment is responsible for more turf troubles on greens than all other causes combined, and arises from failure to provide soil of suitable make-up during construction, or the use of undesirable soil in subsequent top-dressings. Either cause is lamentable because it is impossible to quickly change the soil after the surface is covered with turf. The limited areas occupied by greens makes it practical to modify the soil during construction and thus to provide the best possible medium for turf growth. Furthermore, when the soil foundation is satisfactory, turf maintenance is simplified and the danger of serious disaster during the hot, trying, mid-summer months is greatly minimized. The present tendency is to demand perfect putting surfaces at all times, which necessitates even more attention to details of soil than ever before.

Work for Good Root System

The soil is essentially a medium for the development of the turf roots, and a healthy extensive root system is always the forerunner of robust turf structures. Water and most of the essential plant food elements are obtained from the soil, but roots also withdraw oxygen which is contained in the soil air. Of these the water and air relationship is most important, for plant food can be supplied readily, but it is difficult to change the capacity for air and water.

Mineral particles derived from the weathering of rocks, and organic matter produced from plant and animal residues are the two main solid constituents of all soils. Depending upon the preponderance of organic or mineral matter, two broad groups are recognized. The organic soils, either peat or muck based upon the extent of decay, occur in marshes and poorly drained areas, where excess moisture pre-

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vents or retards disintegration of the plant structures. They are of limited extent and in themselves not suitable for greens. The excessive use of peat or muck to modify the physical condition of heavy mineral soils may lead to trouble because of their tremendous water-holding capacity, and the tenacity with which the water is held. In extreme cases, during periods of heavy and continuous rains, or by constant over-watering, the soil remains saturated with water and the roots deprived of oxygen, suffocate and finally die. It is almost impossible to cope with unfavorable weather conditions when the physical make-up of the soil is wrong.

Look to Organic Matter

Soils in which the mineral particles predominate are most common on golf courses. The presence of organic matter in the surface soil is its distinguishing characteristic and serves to differentiate it from the deeper subsoil. During decay plant residues are converted into dark colored substances designated as humus, so depth of color serves as a rough indicator of the amount of organic matter present. The almost complete absence of organic matter is one cause of failure when attempts are made to grow turf on areas from which top soil has been removed. The organic matter improves soil structure, increases water-holding capacity and is essential to the life and development of soil micro-organisms. The preference for black soils is so universal that they are prized above all others. While desirable, there are other properties of greater importance from the standpoint of greens. A light colored sandy loam is far superior to a black clay as a medium for turf maintenance. When the properties of the mineral particles receive the attention they deserve, turf maintenance will be easier.

The size of the predominant or important soil grains determines pore space, ability to hold and move water and also influence the rate at which plant food elements are made available. In order to classify soils, the particles are grouped into three main separates, sand, silt and clay. Sand includes the larger grains and is further subdivided into coarse, medium, fine and very fine. The clay particles are exceedingly minute and, by virtue of that fact, even small amounts of clay exert profound effects. Based upon the proportion of these separates, soils are designated as sands, sandy loams, loams, silt loams, clay loams and clays. These terms are commonly used without realization that the amounts of sand, silt and clay are the determining factors. From the practical standpoint, the effects of sand and clay are most important. A sand soil is one containing 80 per cent or more of the separate sand, the balance may be all clay. A clay soil, on the other hand, contains 30 per cent or more of the separate clay, the balance may be sand. Thus the addition of only 10 per cent clay may change a soil from one extreme to the other. To modify a sand, very little clay is required, but large amounts of coarse sharp sand are needed to materially change a clay.

From the physical standpoint, the sandy loams and loams are the best suited to greens. They contain both large and small particles which assure abundant pore space of sufficient size to provide good aeration, hasten rapid removal of excess water, facilitates rise by capillarity, and yet they have adequate water holding capacity.

Water and Air Division

Under ideal conditions, soil water exists as a film surrounding the soil particles and it is from these films that the root hairs absorb water as they advance. Surplus water beyond that necessary to surround the particles is of doubtful value to the grass, and may be positively harmful. It fills spaces which should be occupied by air, and in extreme cases, where the soil is completely saturated, all air is excluded. This is detrimental to turf growth and also to the development of desirable soil bacteria. Water is a poor conductor of heat and tends to lower soil temperatures. In the spring, excess water often retards initial turf growth by preventing the soil from reaching temperatures at which growth can commence. Supplementary drainage may be required to provide for rapid removal of surplus water, especially where subsoils are so compact and impervious that downward movement of water is retarded. Neglect to insure good surface drainage is a further menace. In periods of heavy precipitation, the downward movement of water may be too slow to rid pockets and depressions of water which should be carried off rapidly at the surface. So-called sun scald or winter kill may destroy turf in such areas.

The promiscuous use of supplementary water is a dangerous practice. Other things being equal, the amount of growth parallels moisture supply up to a point

During construction of the new Evergreen Golf Course (Vancouver, Wash.), a Caterpillar 30 tractor made short work of the land clearing

where additional water becomes harmful by restricting the air supply. Abundant moisture produces soft lush leaf structures, which cannot withstand intense heat or severe wear, and such tissue is more susceptible to irreparable damage by fungus diseases. On undulating greens uniform watering may deprive high areas of water and result in too much on low areas. Insufficient water encourages shallow root systems, and if the soil is allowed to dry completely, it tends to shed water, thus retarding re-absorption.

The surface soil is more than so much inanimate matter. It teems with microscopic life and undergoes constant change throughout the growing season, as a result of the activity of these minute factors. Without their presence, plants cannot exist. These micro-organisms are the scavengers of the soil, for they attack and break down plant and animal residues, which are utilized as a source of energy and food. During decomposition, the plant food elements contained in the complex organic matter are resolved into simpler compounds which the turf can utilize, carbonic acid is also released by them and is further augmented by excretions from the turf roots. The carbonic acid exerts a solvent action on the insoluble plant food elements contained in the mineral soil grains.

There are two types of soil organisms, the anaerobic, which thrive in the absence of air, and the aerobic, which demand oxygen. The anaerobic organisms prodominates in water saturated soils and may produce products unfavorable to turf growth. It is the desirable aerobic organisms which must be fostered. Conditions favoring their development are, a well aerated soil, containing decomposable organic matter, moisture and mineral plant food elements. Their activity is depressed by low soil temperatures and medium to extreme soil acidity. When conditions are made favorable, they multiply rapidly and, although invisible, are tireless workers.

Turf depends upon the soil for seven of the ten chemical elements essential to normal and complete growth. It is obvious that these must be present in forms which the roots can take up. Almost without exception, soils are plentifully supplied with four, but may be deficient in one or more of the elements, nitrogen, phosphorus and potassium, sometimes referred to as ammonia, phosphoric acid and potash. Nitrogen occurs in the organic matter, so light colored soils contain less nitrogen than those of dark soils. Even so, if the organic matter is in forms which resist decay, additional nitrogen must be supplied. Almost all the phosphorus and potassium are in the mineral soil fraction and are more prevalent in the finer particles, except that phosphorus is always least abundant. Sands are frequently low in potassium, while it is plentiful in the loams and clays. From the standpoint of golf course turf, nitrogen is easily the dominant element, phosphorus and potassium playing minor roles. Only when all other soil factors are favorable does fertilization become entirely effective, and only then can maximum results be expected from their use.