How and Why of Water's Effect on Golf Course Grasses

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(*Continued from last month*)

Golf courses are frequently built on soils that require much treatment to make them suitable for growing turf. One of the most frequent soil defects which is encountered is the lack of sufficient organic matter. With clayey soils, this causes a compact structure with excessive runoff, baking and cracking in hot dry weather accompanied by great losses of moisture by evaporation, and poor structure which reduces the water-holding capacity as well as aeration. With sandy soils, the lack of sufficient organic matter permits rapid percolation of moisture through the soil thus carrying off the soluble nutrients which the plant needs, and insufficient moisture is retained for plant absorption. Loam soils are not so urgently in need of organic matter as clayey and sandy soils, but they are greatly improved by its presence in liberal quantities.

We have conducted experiments at New Jersey on the value of different types of organic matter for improving the physical condition of soil. Certain of the results obtained are given in *Table* 4. The detailed discussion of these experiments will soon be published elsewhere, but the data given here show clearly that the available water-holding capacity may be changed considerably by the incorporation of the right type of organic matter. The real value of the various types of organic matter must not be judged by these data alone, since such factors as the texture of the materials, the ease with which they take up moisture, their persistence in the soil, etc., must be considered. The important information contained in these figures is that grass growth was increased over 50 per cent on the sand, and at least 15 per cent on the clay by the incorporation of organic matter in quantities equivalent to about 30 tons of manure per acre.

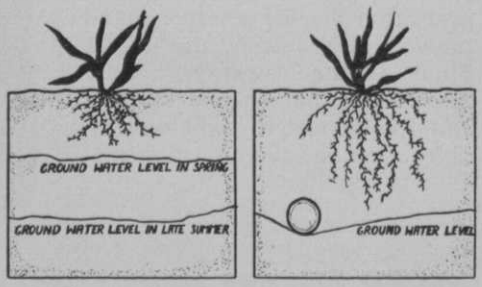


Chart 3.

Absorption of Moisture

Whatever the structure and moisture holding capacity of the soil, the plant will not use such water unless the soil is occupied by the root system. Roots of turf

Table 4. Effect of Adding Organic Matter to Soil, on Water Holding Capacity and Growth of Grass

Type of Organic Matter Mixed With the Soil	Sandy Soil — Available Water Holding Capacity %	Sandy Soil — Yield of Grass gms.	Clay Loam Soil — Available Water Holding Capacity %	Clay Loam Soil — Yield of Grass gms.
Cultivated New Jersey Peat	19.6	9.8	29.0	11.0
Raw Michigan Peat	20.2	8.9	31.8	11.1
Imported Peat Moss	27.6	10.0	34.1	10.8
Spent Mushroom Soil	17.8	9.5	27.6	11.6
Well-rotted Manure	18.3	10.4	31.3	11.6
Untreated Soil	16.1	6.2	26.0	9.6

grasses are stimulated by some conditions and inhibited in growth by others. Poor soil drainage always means scanty root development. This is largely due to the exclusion of oxygen from the pore spaces by the presence of too much water. *Chart No. 3* shows the relation between drainage of a wet soil and root development. In some soils, poor drainage is caused by the presence of a compact layer of clay or shale which prevents removal of superfluous water by percolation. In others, the soil itself is naturally so compact that excess moisture is not eliminated normally. However, in many cases, poor drainage is the result of continuous over-watering which compacts the soil. The roots of turf plants find difficulty in occupying such soil and therefore may penetrate only the upper layers. This unhealthy condition may pass unnoticed until a period of hot dry weather occurs, when the turf suddenly fails because it is not able to satisfy its moisture requirements by absorption from the thin surface layer of soil. Paradoxical as it may seem, over-watering may easily result in injury from moisture deficiency. On the other hand, the soil must contain a certain supply of water or roots will not grow and function. A system of watering which provides for wetting of only the upper inch or two of soil, will force the plants to confine their root systems to this moist layer. A sudden heavy watering to a greater depth will have little benefit, since the plant can draw only on the soil zones occupied by the root system.

Another factor which greatly influences water absorption is the acidity of the soil. Some grasses, such as the bents, are more tolerant of acidity than others, such as Kentucky bluegrass. Nevertheless, it is a well known fact that strong acidity will prevent the formation of root hairs and thus reduce the absorption of moisture. Moreover, even with contact of roots and water, it has been shown that absorption is much slower with strong soil acidity than with mild acidity or neutrality. We have found striking support of this fact in our tests with creeping bent turf in New Jersey. Where the soil has become acid through use of sulphate of ammonia, ammo-phos, and similar fertilizers, the turf suffered a great deal more from lack of moisture during the dry season of 1930, than other plots receiving the same care but having lower degrees of acidity.

The system of fertilization followed has great influence on root development and the absorption of water from the soil. Phosphate fertilizers have in general been found to increase the extent of the root system greatly. A very large percentage of soil in the eastern half of the United States are known to be lacking in phosphorous, which means that attention must be given to correcting this deficiency by proper fertilization.

Quite contrary to the effect produced by phosphates, nitrogen in abundant quantities is known to reduce root development. This is particularly true when the element is supplied in the form of soluble fertilizers such as sulphate of ammonia, nitrate of soda, and urea. Physiologists have discovered that when the supply of nitrogen absorbed is great in proportion to the food made in the leaves, the development of roots is retarded. On the other hand, if the supply of nitrogen is relatively small as compared with food reserves, root development is stimulated. It is clear therefore, that nitrogen must be supplied in small quantities but in a regular manner, if normal development of the plant is to take place. Nitrogen is less likely to be applied in excess if it is in the organic form, such as tankage, cottonseed meal, castor pomace, and similar materials. These substances must decompose before the nitrogen is released for plant use, and the quantity available at any one time is not likely to destroy the balance within the plant. It is very important that soluble nitrogenous fertilizers be applied in small quantities. Even though burning may be avoided, large amounts will stimulate a rank growth of juicy tender stems and leaves without a corresponding root development.

In addition, it may be well to remember that poisonous materials such as copper, will kill roots even though the copper be combined with other substances, as in Bordeaux spray. A thin layer of poisoned soil prevents roots from developing in this zone, and also eliminates the possibility of utilizing the moisture or nutrients in soil below this layer. Some poisons like copper are stationary in the soil, but others such as chlorates may be washed out.

Quantities of Water Required

The water requirements of turf grass are not great in themselves. If moisture loss by runoff, percolation, and evaporation could be avoided, and the rainfall stored for use by the plant as required,

there would be little need for artificial watering. There are no accurate figures available on water requirements of turf grasses, but I have calculated the approximate quantities of water used by grasses cut at fairway length. These data are given in *Table* 5. The amount of water required day by day varies with the weather as shown in the table. It is likely that the quantity required daily in extremely hot dry weather might even be double the average for July. However, even if 45 gallons of water were required daily to prevent wilting of the plants, a sandy soil should contain enough moisture in the surface inch to meet this need for 2 days.

Table 5. Calculated Daily Water Requirements for Grass per 1,000 Sq. Ft.

	For Season April-October	For July Only
Massachusetts—		
Fertilized grass....	11.0 gals.	22.0 gals.
Unfertilized grass..	8.4 gals.	16.8 gals.
New York and Vermont—		
Average grass	16.0 gals.	32.0 gals.

Based on water requirements of Shantz & Piemeisel, Jour. Agr. Res. V. 34. 1927

Grass yields from pasture experiments, Cornell Bul. 424, *Vermont Bul.* 295, *and Jour. Amer. Soc. Agron. V.* 21, 686-699. 1929 (*for Mass.*).

Actually, the loss by evaporation on a sandy soil is probably as great as that of transpiration. Unless the roots have occupied layers of soil to a depth of 3 or 4 inches, daily artificial watering is a necessity on such soils, no matter whether the turf is on greens, tees or fairways. The moisture situation is not so critical on loamy soils because of their greater water-holding capacities, but considerable water is lost by runoff, percolation, and evaporation, and if root systems do not occupy more than the upper inch or two, severe injury may be expected in droughty periods.

Height of cut greatly influences root system development. All of the plant's food is made from water, minerals, and carbon dioxide gas, in the leaves of the plant. Close cutting removes a part of the leaves, and the closer the mowing the smaller is the leaf area remaining for the manufacture of food. New roots may be made only with food manufactured in the leaves, and the net result of close mowing is therefore shallow root development. If close mowing is accompanied by heavy nitrogen fertilization, root development is still further reduced, making the grass very susceptible to drought injury as well as other ailments. Close mowing on greens is unavoidable, but there is little need for mowing fairway closer than ¾ of an inch. The drought injury suffered in 1930 by many golf courses was probably greatly increased by the practice of mowing closely, a custom which has become prevalent in recent years.

Moisture Supply and Quality of Turf

The greenkeeper is not so concerned with the quantity of grass produced as the quality. The supply of water has much effect on quality. When a watering system has been established making it easy to supplement natural rainfall by irrigation, the tendency is to use more water than is desirable. The ill effects of continued over-watering on soil conditions has been discussed, but the direct effect on the grass itself is perhaps still more important. The grass leaves are modified in both size, and ability to endure harsh treatment, by the quantity of water supplied during their development, as shown in *Chart* 4.

In general we may say that the smaller the supply of water during leaf growth, the smaller will be the individual leaves, but the greater will be the thickness of the cell walls, the greater the development of strengthening tissue and the lower will be the content of moisture. Grass developed with a relatively small supply of water will therefore be much better able to withstand the wear given turf on golf courses than that given an abundant supply. It is true that growth is slower with less moisture, but on the other hand the grass produced under such conditions will

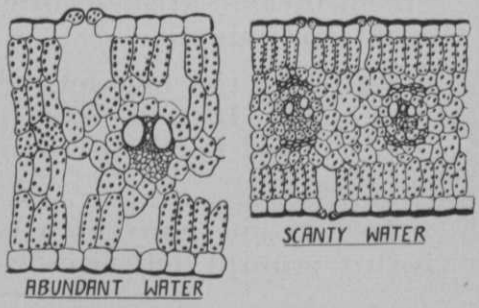


Chart 4.

suffer much less when droughty periods occur, and will also be less susceptible to disease.

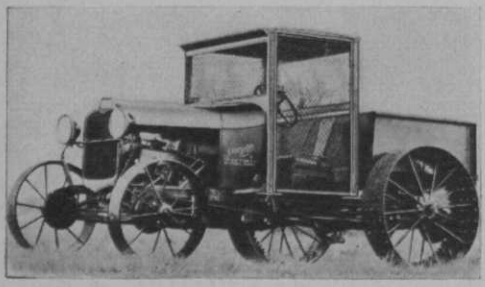
In watering one should always moisten the soil to a depth as great as that desired for the root system. Periodic moistening to a depth of 4 or 5 inches is far more desirable than daily sprinkling which penetrates only 1 or 2 inches. The ideal system of watering for the golf course should be one in which only enough moisture is provided for rather slow but hardy growth. Wilting should be avoided when possible, but it is better to run the risk of occasional wilting than to supply excessive moisture and produce soft tender turf susceptible to injuries of many kinds.

STAUDE PRESENTS SAFETY-FIRST CAB FOR COURSE WORK

St. Paul, Minn.—Greenkeepers have long recognized the need of protection for the tractor operator against flying golf balls, time lost waiting for players to tee off, etc.

E. G. Staude Mak-a-Tractor Co., manufacturers of the Staude general utility golf course tractor, has recently placed on the market a steel wire mesh cab which gives full protection to the operator against accidents of this nature, besides permitting the operator to save time by going ahead with his work instead of having to wait for players to play off.

This time saving alone, to say nothing of the protection against accidents, is worth the $50 cost for the cab. The cab also acts as a sunshade and the manufacturers claim



it can be attached quickly and easily to any Model "A" Staude tractor.

The 1931 Model "A" Staude golf course tractor has many improved features over any of their previous models, although there has been no increase in price, the makers remind the greenkeepers. Just a few of the improvements are: motor equipped with air cleaner, reinforced Ford frames, tractor wheels have rolled edge rims, pinions fitted with Alemite fittings, all steel cubic yard dump body has automatic tail gate, tractor lugs are case hardened, etc.

E-Z-T IS NEW AID FOR PRACTICE AND TUITION

Toledo, O.—A perfect tee, easily and invariably, is the promise made by the new E-Z-T, being introduced by the International Golf Equipment Co.

Any number of golf balls up to 50 may be placed in a hopper, from which they are fed by a gravity control, to a flexible rubber tee, as fast as the golfer cares to drive them. The machine is operated by pushing a pedal with the golf club after each drive, to tee the next ball.

The tee is mounted on a flexible arm, and if the stroke happens to be too low, it instantly springs forward and out of the way as the club touches it. Surrounding the tee is a resilient mat of sponge rubber, moulded to resemble turf, with an inlaid band of tough black tread rubber, which describes the correct arc for perfect swing and follow through.

The E-Z-T makers point out that it relieves the pro of one of the most burden-

some features connected with lessons, as without a teeing device, he must take up practically half the study hour teeing balls and seeking tees. Now he can concentrate entirely on the pupil's adaptability to his teachings.

On an exceedingly hot and humid day, the average pro is physically fatigued from stooping over the balls for his pupils. Many pros are subjected to severe headaches and often lay off teaching until evening. With E-Z-T at least fifty per cent of the physical exertion of either player or pro is eliminated. E-Z-T also supplies a turf or driving surface which will satisfy the most exacting type of player.

SHALER OPENS CHICAGO OFFICE WITH ROBERTS

Chicago, Ill.—Edward G. Roberts, well known in the playing and course equipment business, has opened a Chicago office for the Shaler Co., of Milwaukee and Waupun, Wis. Roberts' quarters are at 998 Merchandise Mart. He has samples and stock of Shaler clubs, balls and bags.