SOIL WATER AND SOIL AIR: THEIR RELATIONSHIP TO TURF PRODUCTION

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Greenkeeping superintendents and others interested in turf production are becoming increasingly aware of the importance of maintaining a proper balance between soil moisture and soil air. In order to understand the relationship of water and air in the soil, it is necessary to become acquainted with a few basic facts.

Soil ordinarily contains about 50 per cent of solids and about 50 per cent of voids, or pore space. A sandy soil usually contains a little less than 50 per cent pore space, and a heavy (fine-textured) soil ordinarily contains a little more than 50 per cent pore space.

The pore spaces in soil are of two kinds: capillary pore spaces and non-capillary pore spaces. The capillary pore spaces are important from the standpoint of the moisture-holding capacity of the soil, while the non-capillary pore spaces are of greater importance from the standpoint of aeration. The pore spaces of the soil must be filled by either air or water. When the water comes in, air goes out; when the water goes out, air comes in.

Soil water may be divided into three classes: **Gravitational** water is that water which percolates through the soil and drains out by the force of gravity. **Capillary** water is that water which is held as a thin film around the soil particles and which is held against the force of gravity; this is the water that the plant depends upon for its supply of moisture. **Hygroscopic** water is that water which is held very tightly by the soil particles and which cannot be taken up by plant roots.

Therefore, the capillary water is the kind with which we are most concerned. A good soil holds a great deal of capillary water, but it also contains enough non-capillary pore spaces to allow the gravitational water to percolate readily through the soil.

COMING EVENTS

Aug. 8—New Jersey Field Day. New Jersey Agricultural Experiment Station, New Brunswick, N. J. Ralph E. Engel. State College, Pa. H. B. Musser.
Sept. 6-7—Rhode Island Field Day. Rhode Island State College, Kingston, R. I. J. A. DeFrance.
Sept. 11-12—Penn State Field Day. Pennsylvania State College.
Oct. 15-16-17—Third Annual National Turf Field Day. Beltsville Turf Gardens, Plant Industry Station, Beltsville, Md. Fred V. Grau.
Oct. 25-27—Central Plains Turf Foundation Turf Conference, Manhattan, Kan. L. E. Lambert.

Soil structure, or the arrangement of soil particles, is also an important consideration. Many good agricultural soils are made up of fine particles which are aggregated into composite granules, or crumbs. Soil under turf, which is subjected to traffic in both wet and dry weather, often undergoes a structural change. The aggregates, or crumbs, are broken down and rearranged in a more compact condition. This breakdown of structure in the upper portion of the soil produces the condition which is known as surface compaction. When soil particles are rearranged and fitted together more closely, the amount of pore space is diminished, the movement of water through the soil is hampered and air is virtually excluded from the soil.

The foregoing considerations all relate to the conditions affecting the balance between the moisture content and the air content in the soil. It is necessary to consider the needs of the plant with reference to this moisture-and-air relationship. Plants take in water through their roots. It is generally believed that the transpiration of water from plant leaves exerts a pull or tension on the soil moisture.

However, it has been proved by a number of experiments that oxygen must be present at the surface of the plant roots before water can be taken into a plant. When oxygen is lacking, root cell membranes are impermeable to water. Therefore, under certain conditions it is possible for a plant to wilt while the roots are standing in water. Almost every greenkeeper has observed this condition on a putting green and has supposed that the green was suffering from "scald." While this may seem impossible, the green actually was suffering from drought because air was lacking and the grass roots were impermeable to the abundant soil moisture.

The plant also requires oxygen for the process of respiration. Respiration provides energy, and the plant requires energy for the intake of nutrients, The salt solution in grass roots (sap) is much more concentrated than is the soil solution. Ordinarily under such conditions the nutrients would move out of the plant roots and into the soil. The energy produced by the process of respiration enables the plant to absorb nutrients against the gradient. Thus it is shown that in the absence of oxygen, the grass plants cannot provide the energy necessary for food intake. In the absence of good aeration, grasses may be poorly nourished even though there may be a plentiful supply of available nutrients in the soil.

The practical turf grower need not remember all the details of the complicated relationships which exist between the plant and its environment. He should remember, however, that it is important to maintain a proper balance between air and moisture in the soil. He should also remember that surface compaction and poor drainage are the two greatest hindrances that are encountered in the maintenance of proper soil-moisture and soil-air conditions.

TURF PICTURE AT BELTSVILLE

Bluegrass

Spring got off to a slow start. March and the greater part of April were cold and dry. The rains came in May—21 days of rain, along with cool weather. As a result of these weather conditions, the soil became saturated and common bluegrass, where grown alone, was severely damaged. Large areas of the bluegrass turf that surround the Plant Industry Station have rotted out. This has occurred on the high spots as well as on the flats. Merion (B-27) came through with flying colors.

Bents

Disease was severe on bentgrass. Helminthosporium leafspot (no known chemical control) was most severe on our creeping bent plots. These plots, consisting of bent selections which are being evaluated for disease susceptibility, were also damaged by dollarspot. No chemical control is being used. However, two strains, Arlington (C-1) bent and experimental strain (C-115) from Dahlgren, Va., came through this trying period relatively free of disease. All others (more than 100 under test) were damaged with varying degrees of severity.

Tall Fescues

Our 17-acre front lawn of Alta fescue has been outstanding all spring. Justice fescue, a strain developed by Dr. E. N. Fergus, of the University of Kentucky, was superior to all other tall fescues under ½-inch mowing test. Common Alta, mowed continuously for the past three years at ½-inch, is being allowed to seed for future breeding work and selection.

Zoysia Japonica

Zoysia japonica was a full 10 days earlier than U-3 Bermuda in greening-up this spring. It is now growing actively and presents an ideal turf. *Zoysia* looks more and more like our lawn and fairway grass of the future. Outstanding selections were increased in the greenhouse last winter for planting this June.