How Soils Affect Water Usage

J. R. Watson, V.P., Agronomist
The Toro Company, Minneapolis

Water is essential for plant growth and plant activity. It is involved either directly or indirectly in all phases of the care and management of turfgrass. Water is necessary for germination, for cellular development, for tissue growth, for food manufacture (photosynthesis), for temperature control and resistance to pressure. It acts both as a solvent and as a carrier of plant food materials. Nutrients dissolved in the soil by water are taken in through the roots and then carried to all parts of the grass plant in water. The food manufactured in the leaves also is distributed through the plant body in water.

Soil affects watering practices because it is the reservoir from which the plant obtains the water needed to sustain its growth and development. Thus, effective and efficient water usage on golf courses demands a knowledge of the basic physical and chemical soil properties and how these relate to water absorption, storage and drainage as well as the frequency, rate and manner in which water must be applied to turfgrass. Further all such basic information must be correlated with the requirements for color, play or use, adjusted to fit the existing or planned irrigation facilities, and modified to suit the level or standard of maintenance at which the golf course is being kept or maintained.

Golf course soils, as for any turfgrass site, must provide support for the turfgrass, provide a firm uniform footing for the player, serve as a storehouse for nutrients, supply oxygen by providing for exchange of soil and atmospheric gases and act as a reservoir for the water used by the turfgrass plants.

The texture (size of soil particle), structure (arrangement of soil particles) and porosity (percentages of soil volume not occupied by solid particles) of a soil are the basic physical factors which control the movement of water into the soil (infiltration), through the soil (percolation) and out of the soil (drainage).

Texture, structure and porosity, along with organic matter content, determine the water-holding or reservoir capacity, control the air-water relationships and drainage characteristics of the soil. All directly affect watering practices and hence impact directly on water usage.

The intake of water is through the roots, actually through root hairs as they are the organs through which water is taken into the plant system. Hence, the depth of rooting, the extent to which a given root system occupies the soil, the age of the roots and the supply or number of root hairs all affect the depth to which the soil should be wet. The volume of soil that is occupied by active roots represents the soil reservoir for that plant. When high evapotranspiration (ET) rates occur the need for water is great and the reservoir may have to be replenished frequently, especially if the root system is shallow and the soil sandy.

For example, if the need for moisture is 0.25 inches daily, as the case may be during the heat of summer, the soil must supply to the plant, 0.25 inches of water between irrigations. Soils that are otherwise very good for putting greens may hold only 0.5 to 0.75 inches per cubic foot. This would be an adequate amount of water for one to two days if all of it were available to the plant. For this to be the case, the roots must

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(Water Usage cont'd.)
extend through (permeate) the entire volume of soil to a depth of 12 inches. If the roots are only three to four inches, obviously the soil may have to be replenished more frequently — irrigated daily or even twice daily. With a limited root system or one that does not fully occupy the volume of soil; the soil must possess the characteristics necessary to move the needed amount of water at a rate rapidly enough to permit its uptake by the root. Generally, plant water needs can be satisfied if enough supplemental water is applied to replenish that portion of the available water in the root zone which has been used since the last irrigation. Some authorities indicate that water should be added when approximately 50% of the available soil water has been exhausted. Thus, if the roots fully occupy the soil to a depth of six inches and the soil holds one inch per cubic foot, the ET rate is 0.25 inches per day, the green must be watered daily, since 50% of the potentially available water will have been used in that period of time.

Enough water should be applied to ensure that the entire root zone will be wetted. Too, on natural soils, as opposed to those modified for intensive use (golf greens and bowling greens), sufficient water should be applied to bring about contact with sub-soil moisture. Continuous contact between the upper and lower levels of moisture will avoid development of a dry layer through which roots cannot penetrate.

Under arid or semi-arid conditions, or any location where salts may have, or will accumulate, water must be added in quantities greater than is actually required to satisfy the water needs of the grass or to replenish the soil reservoir. This is necessary to ensure periodic "flushing" of the soil to remove the salt accumulations.

Application of too much water at one time (misuse) is serious when the soil is poorly drained and the excess cannot be removed within a reasonable period of time. Such a situation is more critical in saline or salty areas or when saline water is being used. When such conditions obtain, water usage must be modified.

Soils have little direct affect on plant usage of water. Plant use of water is a solar driven phenomenon. The water evaporated and transpired as a result of this solar energy is approximately equal to that required to meet the plant's need. This relationship must be clearly understood to make efficient use of this vital, and dwindling resource.

Prepared for: Golf Architects Meeting, GCSAA Annual Conference, January, 1987, Phoenix, AZ.

Measuring Roots' Muscle Power

As plant roots grow toward water and nutrients, they exert pressures of up to 150 pounds per square inch, often splitting granite boulders and upheaving sidewalks and streets in the process. U.S. Department of Agriculture scientists are studying root pressure and growth in order to breed plants that can better penetrate compacted or dry soils. For these studies, the scientists invented special research tools, including a miniature pressure gauge less than five-millionths of an inch in diameter to record pressure inside individual root cells, and sensitive rulers to measure root growth — often less than one thirty-second of an inch per hour. These tools have allowed detection in growing root tips of minute pressure changes caused by the plant's response to its environment, and give scientists some indication of the roots' muscle power.

Pictures from the Inverness C.C. Meeting held in April

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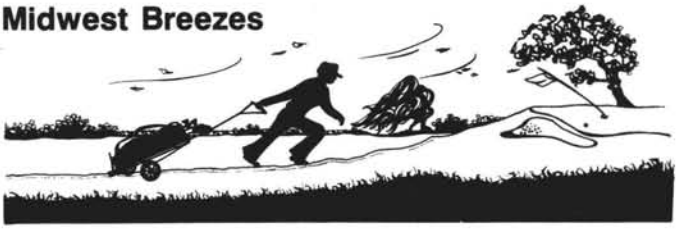
Midwest Breezes



Upcoming Events — Mark Your Calendar

June 4 — MAGCS meeting at McHenry C.C.
June 11 — Pro/Supt. Golf at Country Club of Illinois
July 14 — MAGCS meeting at Village Greens of Woodridge
August 24 — MAGCS meeting at Turnberry C.C.
September 21 — MAGCS meeting at Balmoral Woods G.C.
October 8 — MAGCS meeting at Woodstock C.C.
November — Annual meeting
December 8-10 — NCTE at Pheasant Run, St. Charles, IL

Midwest Breezes

While I was in Minneapolis I was surprised to find out that in late April the Minneapolis area was a good two weeks ahead of the Chicago area. Minneapolis had a very mild winter the same as us and it has been very dry for them also. I saw a lot of dead pfitzers around the area due to an open and dry winter. They may lose 50% of the pfitzers due to the winter. The turf on the other hand was looking pretty good.

Only Two Months Left!

Two months left for what? Why, to become eligible to compete for the annual Ray Gerber Editorial Award. Remember this is a traveling award plaque that has your name engraved on a plate and you get to keep it for one year. You also get a smaller plaque with your name on it to keep. The contest runs from September thru August and you must be an active golf course superintendent to win. Up thru June this year we have only four superintendents who have qualified so far. Come on guys, let's get into this and write an article for **"The Bull Sheet".**

Joe Williamson has left Turf Products and has gone into the real estate game. Joe left Turf Products the middle of April and due to the timing it was not mentioned in the May issue. Good Luck Joe!

Jim Walsh has left Lebanon Chemical Corporation to go into a business for himself. Not sure what business Jim has gone into. If anyone hears, let me know and I'll mention it next month.

Our one and only P.V. gave a talk to the Canadian Golf Course Superintendents Association in March at St. Johns, New Brunswick. The title of the speech, "Wildflower Connection". Surely everyone knows who P.V. is after learning where the talk was given and the subject. If you don't — you're a rookie and need to do your homework and learn who your fellow superintendents are.

"Prospective"

June — the last little Gal of Spring,
Carries Summer in on Her wing.
Will it be a Tropical Heat Wave,
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Or just a good old Summertime,
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One hunred and fifty members and friends attended the retirement party for Howard Baerwald of La Grange C.C. Howard has been the superintendent there for 33 years. Howard and his wife Jeanette thanked everyone there and wished them all success on their scorecard of life.

There have been reports of turf damage due to burning when you use a turf groomer (verti-cut) too soon after a fertilizer treatment. Like anything else — use a little common sense and proper timing.

The deepest sympathy of the members of the Midwest Association of Golf Course Superintendents is extended to Robert Breen on the passing of his wife on May 17, 1987.

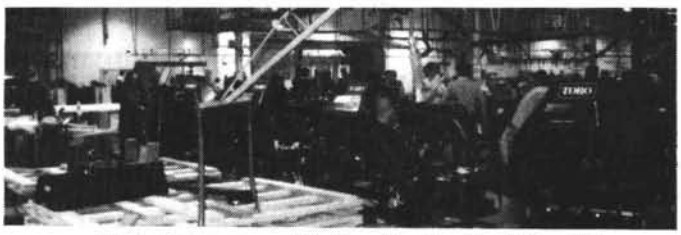
Congratulations to Don and Cindy Cross on the birth of Abilgail Lo on May 4, 1987.

A Trip to Toro

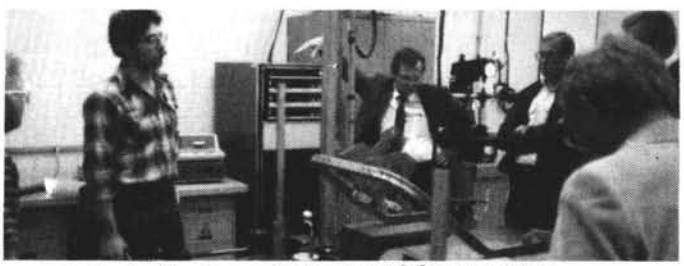
by Fred Opperman

In late April, I had the opportunity to tour the Toro plant and offices in Bloomington, MN. I was impressed with the overall commitment that Toro is taking to give us very well designed and tested pieces of equipment. The CAE, CAD, and CAM computers (computer aided engineering, design and machine) are being used to design our equipment. Everything from the simple bolt to a complex pump or frame can be simulated on this system. The parts can then even be stress tested on the computer screen to determine if there is any weakness or fault. The testing department and the parts warehouse were two other areas that really stood out and made an impression. Toro has just moved into a new parts building with 100,000 square feet of space and they have started a same day delivery if received by 3:00 P.M.

If you ever get a chance to tour one of the plants that make our turf equipment, don't pass it up for you will come away with an education.

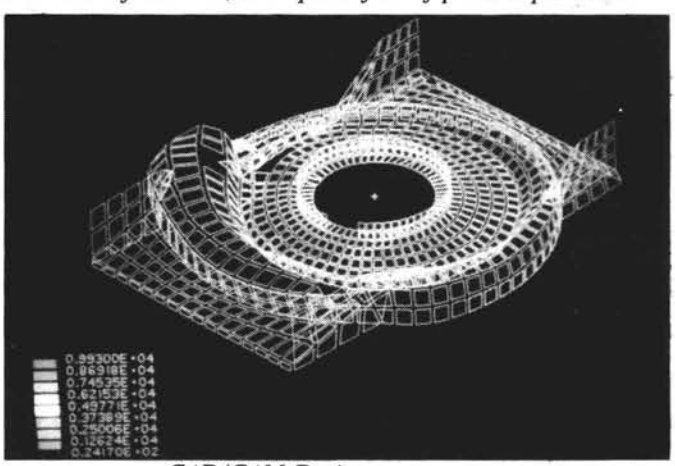


End of the assembly line for the Turf Pro 84



Part of a frame being testzd for accuracy

Part of the 100,000 square feet of parts department



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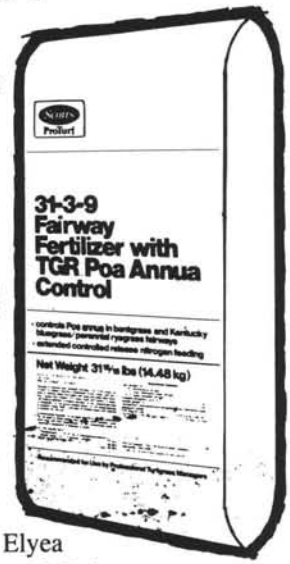

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Localized Dry Spots

by Keith J. Karnok
Dept. of Agronomy, University of GA

The term localized dry spot(s) (LDS) is used to describe the occurrence of an irregular area of turfgrass that for no apparent reason begins to show typical signs of drought stress. Common symptoms include a loss of turgor (rigidity) of the plant to a point that "footprinting" or the inability of the plant leaves and stems return to an erect or normal position occurs following compression by footsteps. Footprinting is often followed by a dark blue/green color of the leaves and stems which is usually followed by severe wilting and eventual death of the tissue. What can be perplexing to the superintendent or other turfgrass managers is LDS symptoms may occur even after a normal irrigation.

There are several possible causes of LDS including excessive thatch, compacted soil, poor irrigation coverage, a steep-sloping grade or hydrophobic soil. If a turfgrass manager is experiencing LDS it's important that he try to determine the cause. Once the cause is known, the situation may be corrected.

However, there is one cause that may be difficult to correct. That is, LDS caused by hydrophobic or water repellent soils. Over the past several years the occurrence of LDS on golf course putting greens seems to be increasing. This is particularly true of greens constructed primarily of sand and established to bentgrass. It is now believed that in many cases, these LDS are the result of hydrophobic soil. The scientific literature shows that water repellent soils have been reported to occur in citrus groves, forests and grassland areas. The only published research on LDS as caused by hydrophobic soils in turf was done in 1978 on an experimental putting green at Ohio State University.

With these facts in mind, research in this area was initiated 2½ years ago in the Department of Agronomy at the University of Georgia. The primary objective was to try and determine the cause of these hydrophobic areas on sand putting greens. Most of the research was conducted by Mr. Kevin Tucker who was in pursuit of an M.S. degree. Kevin's advisory committee consisted of Drs. Keith Karnok, Gil Landry, David Radcliffe of the Division of Agronomy and Drs. Ron Roncadorri and Ed Brown of the Division of Plant Pathology.

The study began in the summer of 1984 of four golf courses (Fairfield Plantation, Hidden Hills C.C., Peachtree G.C. and Summit Chase C.C.) and the experimental putting green at the UGA Turf Plots. Each of these locations had a history of LDS on one or more of their bentgrass putting greens. The remainder of this article will describe the various experiments and results we have now completed.

Experimental Procedures and Results

The first step involved a careful soil sampling of both LDS and immediately adjacent healthy areas from each of the test locations. These samples were taken back to UGA for a thorough laboratory analysis.

The moisture content of LDS soil was significantly lower at all locations sampled than soil taken from immediately adjacent healthy areas. The moisture content of the LDs averaged approximately 3% while the moisture content from adjacent healthy areas averaged almost 21%. A water droplet penetration time test verified that the cause of the LDS was in fact due to a hydrophobic condition of the soil. This test is conducted

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(Dry Spots cont'd.)

by placing a small (.01 ml) drop of water along the length of intact soil cores at ½ inch intervals. The length of time (seconds) required for the droplet to penetrate into the core is recorded. Usually penetration times greater than 10 to 15 seconds indicate a hydrophobic condition. Soil from each of the LDS from all golf course locations showed penetration times greater than 20 second down to the 2 inch depth. At depths greater than 2 inches, the degree of water repellency usually decreased. The average water droplet penetration times from adjacent healthy areas down to the 2 inch depth was less than 3 seconds.

The results of the water droplet penetration time test and soil moisture content clearly demonstrated the presence of a hydrophobic condition. The next question — why was the soil from LDS areas hydrophobic while soil immediately adjacent to these LDS was not? Was there a soil chemical or a soil physical property difference between the two areas?

Soil Physical Analysis

A physical analysis of the soil from each of the sampling locations was conducted. Healthy areas were compared to LDS. Although the soil tested from all locations was predominately sand (92%) there was no significant difference between LDS and healthy areas in terms of sand particle size, silt, clay or organic matter content. The physical analysis provided no apparent clues.

Soil Chemical Analysis

A complete chemical analysis of soil from LDS and healthy areas showed no significant difference in the quantity of the major or minor nutrients present including P, K, Ca, Mg, Zn, Mn,