Localized Dry Spot
Understanding its Causes and Management Approaches
by Wm. Byrnes

The single greatest agronomic requirement of soil is that it provides appropriate (i.e., adequate but not excessive) moisture to the plant root zone. While insuring this under reasonably good soil conditions demands diligence from a superintendent, dealing with the phenomenon of Localized Dry Spot (or LDS) will generally test turf management skills to the limit.

There is a very high probability that LDS is **not** a result of mysterious golf course visits by space aliens. Rather, Localized Dry Spot is a relatively new term that is applied to severe occurrences within restricted areas of a number of different conditions that have been around since time immemorial. To discuss these conditions, a quick review of the terminology used to describe the relationship of some substances contained in soils and their interaction with water may be helpful.

Elementary Science of Soil & Moisture Interaction

For definition purposes, accept that the prefixes "Hydro-" and "Hygro-" both refer to water, or moisture. All substances, in any given conditions are either:

1. **Hydrophilic** (water loving), meaning they have an affinity for moisture. Substances may be moderately hydrophylic and will attract and fairly readily release moisture. They may also be so strongly hydrophylic that they will tie-up water hygroscopically through absorption or adsorption.

2. **Hydrophobic** (water hating) meaning they lack an affinity for moisture. Hydrophobia is also a relative condition. In this discussion we will apply the term *hydrophobic* to describe substances that do not have an active attraction for water, substances that actually repel water, and substances (or conditions) that dry up water.

While all substances are either hydrophylic or hydrophobic, the degree of their affinity or lack of affinity for moisture varies by substance composition and prevailing conditions. Uncompacted clay and organic matter are basically hydrophylic — they have a fundamental attraction for moisture; oil, sand, and alcohol are basically hydrophobic — they respectively repel, shed, and dry out moisture. Figure 1 classifies some representative substances commonly found in the soil environment according to their basic properties in relationship to water.

A. Hydrophylic Substances	B. Hydrophobic Substances
1. Highly/extremely hydrophylic:	*1. Highly/extremely hydrophobic:*
Salt	Oil, Fats, Waxes
Unsaturateded Clay	Saturated Clay
Humus	Alcohol
Unsaturated Fulvic Acid	Saturated Fulvic Acid
2. Moderately hydrophylic:	*2. Moderately hydrophobic:*
Humic Acid	Sand

Figure 1-- Representative Soil Substances and Their Moisture Affinities

Whether and to what degree a substance is either hydrophylic or hydrophobic depends on the chemical (or electrical) and physical properties of the substance at any given time. As exemplified with clay, a substance can be either hydrophylic or hydrophobic depending on other factors such as saturation.

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All of this has importance because the moisture affinity of any given soil largely determines the amount of the several types of moisture that will exist in that soil. In simplified terms, all moisture enters the soil as free water and then becomes one of three types (Figure 2):

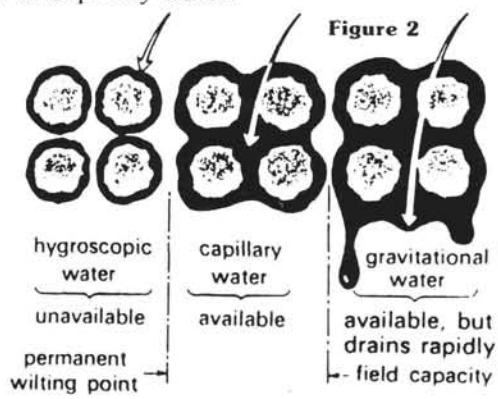
1. *Hygroscopic*, which is water that is *ab*sorbed or *ad*sorbed by soil elements (like clay) and is virtually unavailable for plant uptake except in minute quantities at the point of vaporization.

2. *Capillary*, which is held in a tension between soil elements and is fully available for uptake.

3. *Gravitational*, which is pulled downward through the soil profile by gravitational forces and is only briefly available for uptake by roots.

Highly hydrophylic soils promote existence of hygroscopic water; highly hydrophobic soils promote existence of gravitational water; moderately hydrophilic soiil promotes existence of capillary water. Primary turfgrass water management goals will obviously include encouraging healthy infiltration and percolation of free water into and through the root zone and creation of a maximum amount of capillary water.

Figure 2



Though there are different understandings of the term LDS in different areas, Localized Dry Spot **always** has its origins in soil conditions discouraging or preventing the existence of capillary soil moisture in the root zone. *LDS differs from other soil conditions only by its degree of severity.*

The Causes of Localized Dry Spot

In order to deal with LDS, it is most important to understand what specific soil conditions might be causing any particular case. For classification's sake, let's consider three general categories which encourage occurrences of LDS. *Please note that none of the conditions is necessarily exclusive of the existence of another or several other causal conditions.*

A. Physical Soil Conditions Inhibiting Infiltration

These would include compaction, steep slopes, and reasonably dense, undecomposed thatch mats at the soil surface level. Moisture which does not enter the soil is not going to be available to the root zone.

B. Soil Conditions Promoting Excessive Gravitational Flow and Drying or True Hydrophobic (water repelling) Activity

All of these circumstances discourage the existence of capillary moisture. The following specific conditions qualify:

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1. **Absence or Defiency of Hydrophylic Soil Substances.** Very high or pure sand content areas can create a "chimney" or "flue" effect, magnifying gravitational flow of water since sand has virtually no electrical charge enabling it to interact chemically. Sand is also very prone to heat build-up, leading to exaggerated vaporization during continuous high temperatures and contributing to the phenomenon of "Hot Spots".

2. **Biological and Disease Origin Anaerobic and Hydrophobic Soil Conditions.** These can occur:

a) In conjunction with Black Layer and similar formations, which create anaerobic conditions and in which bacteria produce noxious elements including acetic acid, alcohols, oxides, and sulfites which drastically reduce available moisture.

b) In conjunction with certain fungi, such as the mycelium associated with Fairy Ring which create noxious hydrophobic conditions virtually eliminating available water in the infected soil. A variation of this is so-called "pseudo" Fairy Ring which often occurs on two to five year old "spec" greens, usually in association with thatch problems.

3. **Excessive build up of hydrophobic and/or super absorbent physical soil particle "coatings".** Perhaps the least understood of LDS provoking conditions, researchers have observed a number of causal factors which can lead to such conditions and preclude adequate available moisture:

a) Oil or "fatty" substances, which are low in oxygen and which evolve from plant decomposition and are hydrophobic. These substances are particularly prevalent in soils where vegetation has been burned off at one time or another.

b) Actual petroleum based substances introduced into the soil will obviously create hydrophobia.

c) The dried precipitate of fulvic acid which is, according to its degree of saturation, either highly hydrophobic or hydrophilic. Fulvic acid is one of the organic acids contained in all humus and is isolated in nature by microorganisms breaking down organic matter. This substance can be particularly troublesome in sandy soils.

C. Soil Elements Promoting Excessive Hygroscopic (moisture retention) Activity

Soil with highly concentrated accumulations or organic matter (decomposed thatch layer, etc.), salt, fulvic precipitate, and/or clay attract and take in moisture rendering it unavailable to root systems. Once saturated, of course, some of these substances become hydrophobic.

LDS Management Tools

There are a number of tools to deal with incidences of Localized Dry Spot, and their use follows a common sense logic of cause and counter influence, matching intensity and timing of management measures to the nature of the LDS. In troublesome cases, several approaches may be required if we are to avoid the extreme of soil replacement.

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A. Mechanical, Physical, and Sterilization Treatments

Aerification

While this is a standard practice on golf greens, it is often a paramount importance in dealing with LDS; the trick is to utilize the correct approach to match the nature of the culprit. For instance, coring can be particularly helpful to open up sub-surface layering (mycelium, Black Layer, organic matter, clay), and poor moisture infiltration and percolation soils. As in all aerification, succeeding corings should vary in depth while always penetrating problem horizons. Similarly, tyning will open up infiltration passageways in LDS areas resulting from slopes, hygroscopic material, and surface compaction. An especially useful and often neglected practice in this regard is frequent and vigorous puncturing with a four tyne garden fork **only** in the LDS areas. Water will go where it is most welcome, and we want to emphasize increasing capillary water in the problem spots; presumably, other areas are absorbing sufficient moisture. Drill aerification is a relatively new technique that seems to hit a middle ground and does not seriously damage turf. Our goal with coring, tyning, and drilling is to provide avenues through the surface and/or the problem zones which encourage adequate moisture (and air) to and somewhat beyond the existing root zone. This goal demands that we know the nature and location of our soil problems. Common sense also tells us that hydrojecting, while certainly a helpful practice, will be of lesser benefit as a management tool than traditional aerification for providing major relief for an LDS problem because hydrojecting addresses the critical oxygenation factor only from a temporary standpoint.

Top Dressing

Whenever we attempt to treat a problem we must bear in mind that inappropriate use of some treatments have the potential of creating a new problem themselves. So it is with top dressing. Still, if we are to avoid the radical and expensive alternative of reconstruction, very careful and gradual physical soil element modification can help achieve improved moisture availability in LDS areas. The trick is not to try to change the world overnight and to be intelligent in seletion of top dress mix materials. Before adding any new components to the soil it often is wise to consider the permanence of the new materials, *i.e.*, how reversible is the treatment, as well as the material's potential side effects.

De-Thatching

Anytime a thatch layer builds up beyond about ¼ inch, thought should be given to instituting a mechanical dethatching program. Obviously, depending upon soil composition, microbial population, and climatic conditions, ¼-½ inch of thatch may be looked upon as anything from desirable to extremely unhealthy.

Sterilization

In extreme cases of mycelium-origin soil dysfunction, fumigation may be required.

The remaining article will be continued in the July issue.