The Biology and Control of Localized Dry Spots on Sand Greens

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Hydrophobic (non-wettable) soils occurring on bentgrass sand greens constructed to USGA specifications have been previously described and partially characterized. These areas, which resist wetting, have been termed localized dry spots (LDS). The LDS syndrome starts with the turf turning a blue-green color followed by a loss of turgor and finally shoot dieback. The symptoms observed are usually in irregularly shaped patches of variable size. Frog-eye patches, characteristic of some patch diseases, have been observed, but aren't dominant.

Symptoms are most severe in hot, dry weather. Lower temperatures and adequate water will result in regrowth of the shoot system of plants that survive. Management practices for the control of LDS are inconsistent at best, yet the following practices have aided in reducing symptoms severity. Topdressing with sand that contains a minimal amount of fine particles. As will be discussed later, small particles (especially in the silt-clay size) may tend to aggravate the problem over time. Repeated core cultivation, especially in the spring and fall, has helped reduce the severity of LDS. Wetting agents, which reduce the surface tension of the water, have given some degree of control for LDS, but are best used in a preventative program. Syringing of the greens may be used as a stop-gap measure, but primarily serve to lower the canopy temperature and rarely will alleviate symptoms. Frequently, various combinations of the above strategies are necessary, and a trial and error type of approach is needed to achieve adequate control of LDS.

Previous studies have shown an organic coating is present on sand grains associated with LDS and removal of the coating yields substances with an infrared (IR) spectra characteristic of fulvic acids. Fulvic acids are a diverse group of large molecules, common in most soils, that are extractable in solutions with a high pH and do not prêcipitate when the pH is lowered to approximately 1 or below. Previous studies did not include an extraction of wettable soil from bentgrass sand greens, and so it could not be determined if the fulvic acid associated with LDS was unique compared to those in the wettable areas.

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Studies were conducted at Ohio State University from 1989 through 1991 to provide a more complete characterization of the organic matter and soil characteristics associated with LDS, and included samples from wettable areas for comparative purposes. First, several common classes of soil organic matter were quantified and analyzed structurally using several techniques. Structural analyses of lipids (compounds that are similar to oils) were accomplished by gas chromatography/mass spectroscopy (GC/MS) and the large molecules that were extracted in alkaline solution, i.e. fulvic and humic acids, were analyzed by IR and

(continued on page 24)

(Localized Dry Spots continued)

nuclear magnetic resonance (NMR) spectroscopy. Second, particle size distributions for each size range. While particle size distributions were determined in previous studies, there were no reports of which fractions were the most hydrophobic, if any. Also, the area in the soil profile that displayed the most hydrophobicity was determined using soil columns collected from greens with LDS, allowed to dry down, rewetted from the bottom, and the distance that was infiltrated recorded at one and two minutes. Finally, since bentgrass roots have been reported to be colonized by various fungi, both pathogenic and non-pathogenic, roots associated from wettable and non-wettable areas were stained and examined for the extent of fungal colonization present.

Results obtained from the organic matter extraction and analysis indicated that LDS soils had greater amounts of all organic matter fractions studied than soils that were wettable. The only structural difference observed was from LDS that occurred on greens that were three years old, and this was only detected following an initial extraction with methanol. It appears that there is either a unique structure, or interaction between several structures, occurring in the LDS sample. One possible scenario to explain these results is that a unique structure or structures act to "prime" the LDS areas, and then the syndrome is intensified by subsequent drying cycles, which after several years may mask the unique component that initiated the LDS. The origin of the organic compounds could not be determined, but it is probably derived from bentgrass roots, soil microflora, or both.

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Particle size distribution analysis showed no significant differences between the wettable and non-wettable soils. Hydrophobicity, as determined by how long it took a water drop to penetrate the sample, indicated that particles less than .25 mm in size were the most hydrophobic. Since the greens are constructed with 85-90% sand this size fraction has been largely ignored in previous studies on LDS, but since this is the most chemically reactive fraction, due to the presence of clays, it would not be surprising that this is where organic-inorganic interactions would be the most prevalent. The hydrophobocity was the greatest in the area immediately below the thatch-soil interface. This is the area in the soil profile with the most biological activity, especially in regards to root colonization and thatch degradation. Electron photographs of soil particles that were approximately 0.1 mm in diameter showed that the particles in LDS samples had an extensive organic coating compared to particles from wettable soils.

Results from these studies indicate that the role of the bentgrass root system, and associated microflora, on the development of LDS should be investigated in more detail. Previous studies have attempted to characterize the chemical and physical properties of LDS soils, but the impact of biological influences on its development cannot be ignored.

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