Turfgrass stress, water-repellent soils and LDS

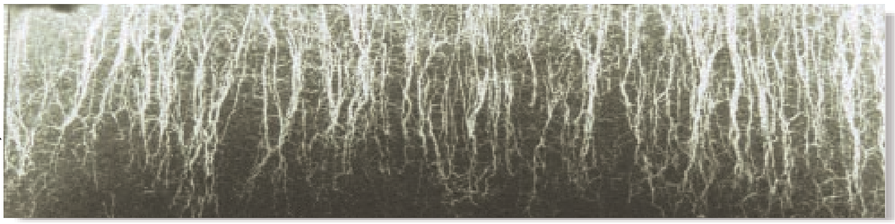
The need to maintain low mowing heights and fast green speeds increases the occurrence of localized dry spots caused by water-repellent soil.

Keith J. Karnok, Ph.D., and Kevin A. Tucker

Superintendents often ask, "Why are localized dry spots and water-repellent soils so much more of a problem today than they were several years ago?" Most would agree that the problem seems to be more prevalent with each passing year, and supporting evidence is found in the more than 50 wetting-agent products that are used primarily to combat the problem.

The number of wetting agents continues to grow each year, but not too long ago only a handful existed, and they were used only in certain situations or on the worst hydrophobic soil conditions. What has changed? Are soils today more prone to becoming hydrophobic?

It is believed that water-repellent soil has always been present to some extent in sand-based greens. Second, the problem has intensified as the specifications of sand root zones shied away from the inclusion of fine-textured materials. It is fair to say that water-repellent soils will continue to be a significant problem for most golf course superintendents.



Photos courtesy of Keith Karnok

Poa annua roots are seen through the observation window of a rhizotron (underground root observation laboratory). Because water repellency occurs most frequently in the top 2 inches of the soil profile, it is important to encourage roots to grow beyond this zone and into the soil below, which is less water-repellent or not water-repellent.

Change in stress levels

Still the question remains, if water-repellent soils have always been present, why have localized dry spots (LDS), particularly on greens, recently become such a significant management challenge?

The answer is one word: stress. Today, the amount of stress placed on greens is significantly greater than ever. The demand for increasing green speeds along with increased play has pushed the turfgrass plant beyond what it can physiologically handle.

Perhaps the biggest culprit in this scenario is the ever-decreasing height of cut. Not too many years ago greens were commonly mowed at 3⁄16 inch. In fact, it was not uncommon to find some courses mowing greens as high as ¼ inch. Today, of course, the standard is ⅛ inch, and greens are mowed to 3⁄32 inch and even lower.

In addition, to help maintain speed and firmness, greens are allowed to dry down to critical levels. Couple those management practices with an apparent rapid increase in surface organic matter, which is partly due to vigorous cultivars and reduced aerification and topdressing, and the superintendent is faced with a new set of challenges.

Water-repellent soils

What does all of the above have to do with LDS and water-repellent soils? Water-repellent soil is most common and most severe in the upper 2 inches of the soil profile, the zone of greatest root growth, organic matter accumulation and microorganism activity, all of which are necessary for the development of water-repellent soil. In most cases, however, soil hydrophobicity decreases with increasing soil depth. At depths of 3 to 4 inches or more, soil is rarely water-repellent. The combination of soil hydrophobicity and low cutting heights results in shallower root systems and plants more prone to LDS.

KEY points

More Info: www.gcsaa.org

- **Stress from cultural practices** has increased the occurrence of localized dry spots (LDS) caused by water-repellent soils.
- **Superintendents** should reduce plant stress by encouraging deep and extensive root systems.
- **Treating an entire green with a wetting agent** can improve root growth and decrease LDS where water-repellent soil is present.

Curiously, the degree of soil water repellency is not always a precursor to LDS. For example, we have seen healthy turf that rarely showed LDS growing in very hydrophobic soil and, a short distance away on the same green, chronic areas of LDS growing in only slightly water-repellent soil. The difference? The degree of stress. The area having the greater soil water repellency happened to be in a low-lying, less-trafficked portion of the green, where it experienced less stress. The areas having less soil water repellency were in elevated areas exposed to the wind and/or more traffic and thus received more stress.

Lessen stress and increase stress tolerance

The key is either to reduce the stress on the plant or to increase the tolerance of the turfgrass plant to stress. Ideally, the superintendent should strive to do both. Typical stress-reduction measures include the use of fans, syringing and traffic management. In addition, practices that encourage a deep root system also improve turfgrass tolerance to stress.

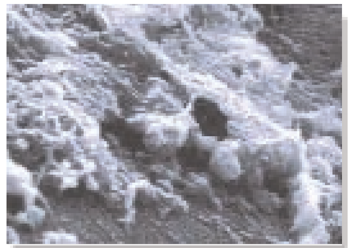
In other words, the goal would be to encourage root growth beyond the zone of water repellency, which is usually the top 2 inches of the soil profile. Management practices that encourage root growth are: using nitrogen in a judicious manner, maintaining adequate phosphorus and potassium levels, increasing cutting height, deep and thorough wetting of the soil to at least 1 inch beyond the depth of the root system, and relieving soil compaction and organic matter accumulation via aerification and topdressing.

Certain plant growth regulators have been shown to help increase root growth. Research by Bingru Huang, Ph.D., Rutgers University, has shown that an increase in cutting height of as little as 1⁄32 inch can significantly improve the health of the turfgrass plant. If necessary, rolling may offset the reduced green speed caused by increased cutting height.

Wetting agents

Wetting agents remain part of an effective program for managing water-repellent soil. The severity of soil hydrophobicity varies across the green, ranging from mild to quite severe depending on a variety of factors. Therefore, the overall wetting and drying characteristics of the soil across the green also vary and can result in nonuniform root growth.

To obtain more-uniform soil moisture across the green, our research suggests that the entire green should be treated with a wetting agent. This permits more-uniform turfgrass growth, especially of the root system. One of the primary advantages of using a wetting agent during the stressful summer months appears to be the reduction of root loss. In our studies with Penncross, summer root loss was reduced more than 25 percent with the use of a wetting agent on hydrophobic soil.



This scanning electron microscope photograph shows a sand particle with an organic coating that has been identified as the cause for water-repellent soils in sand-based golf greens.

Because the severity of hydrophobicity varies throughout a green, it may be necessary in some cases to come back and spot-treat areas that continue to exhibit LDS. These areas are often the most hydrophobic and/or highly stressed.

Applying a wetting agent uniformly across a turf area having varying degrees of water repellency will not result in some areas' holding more water than others. However, varying amounts of organic matter across the green can lead to a variation in the length of time needed for the soil to dry down once it has been treated with a wetting agent. Knowing that wetting agents will cause soil with high organic matter content to retain water longer can be a useful tool for coping with areas exposed to high evapotranspiration rates. Unfortunately, no information is available about the effectiveness of particular wetting agents in soils with high organic matter content.

Applying a wetting agent to a non-water-repellent sand-based green will provide little or no benefit. In fact, in such a situation, using a wetting agent will cause the top inch of the soil profile to drain (dry) even faster as long as there is not an excessive accumulation of organic matter and subsurface drainage is adequate. In most cases, faster drying would be of little advantage in an already well-drained green.

Stress from cultural practices is the main reason for the increased occurrence of localized dry spots caused by water-repellent soils.

Conclusion

Water-repellent soils will continue to be a challenging problem for golf course superintendents. Currently, we have several studies under way that will help us make specific recommendations to superintendents who must combat this problem on a daily basis.

References

1. Huang, B., X. Liu and J. Fry. 2000. Hard summer mowing weakens bentgrass turf. *Golf Course Management* 68(3):60-62.
2. Karnok, K., and M. Beall. 1995. Localized dry spots caused by hydrophobic soil: What have we learned? *Golf Course Management* 63(8):57-59.
3. Karnok, K.J., E.J. Rowland and K.H. Tan. 1993. High pH treatments and the alleviation of soil hydrophobicity on golf greens. *Agronomy Journal* 85:983-986.
4. Karnok, K.J., and K.A. Tucker. 1999. Dry spots return with summer. *Golf Course Management* 67(5):49-52.
5. Karnok, K.J., and K.A. Tucker. 2000. FAQ about LDS. *Golf Course Management* 68(6):75-78.
6. Karnok, K.J., and K.A. Tucker. 2001. Fight localized dry spots through the roots. *Golf Course Management* 69(7):58-60.
7. Karnok, K.J., and K.A. Tucker. 2001. Effects of flutolanil fungicide and Primer wetting agent on water repellent soil. *HortTechnology* 11(3):437-440.
8. Karnok, K., and K. Tucker. 2002. Water-repellent soils, Part I. Where are we now? *Golf Course Management* 70(6):59-62.
9. Karnok, K., and K. Tucker. 2002. Water-repellent soils, Part II. More questions and answers. *Golf Course Management* 70(7):49-52.
10. Tucker, K.A., K.J. Karnok, D.E. Radcliffe, G. Landry Jr., R.W. Roncadori and K.H. Tan. 1990 Localized dry spots as caused by hydrophobic sand on bentgrass greens. *Agronomy Journal* 82:549-555.
11. Wilkinson, J.F., and R.H. Miller. 1978. Investigation and treatment of localized dry spots on sand golf greens. *Agronomy Journal* 70:299-304.

Keith Karnok, Ph.D. (kkarnok@arches.uga.edu), is a professor of turfgrass science in the department of crop and soil sciences at the University of Georgia. Kevin Tucker is a research associate in the department.