

Managing Soil Water

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Algae growth occurs on wet, saturated soils, and indicates a problem that needs attention.

WHEN it comes to managing turf, anyone even remotely in tune with basic agronomics recognizes that putting greens with wet soils are going to cause problems. Equally, golfers know that soft greens, while they may hold a golf shot well, do not play very well. They tend to be soft underfoot, which equates to bumpy and uneven putting surfaces that are more prone to spike marks. Wet greens also seem to putt slower than firmer, drier greens.

The Green Section's agronomists certainly appreciate the problems associated with wet soils in greens. In fact, in a survey of the staff, they listed wet and overwatered greens as the highest-rated agronomic problem in managing putting green turf today.

The agronomic problems associated with wet soils in greens are not lost to golf course superintendents, either. They know all too well that wet, saturated soils are more prone to compaction and result in turf with shallow, weak root systems. *Poa annua* and other weeds tend to be more of a problem in wet, soggy soils, and outbreaks of many diseases can be far worse. Greens that hold water usually are a superintendent's *indicator* greens. That is, if a problem is expected, it will appear first on a wet, pocketed green. Rarely do greens die from a lack of water.

The question is, what can be done about it? How does one manage greens which, once they become wet, stay wet, and how does a golf course superintendent manage excess water in the soil?

By understanding the fate of water in the soil, the golf course superintendent can better manage soil water. The result is better grass with fewer chemicals, and fewer grass failures. Knowing how to manage soil water is an important aspect of establishing an Integrated Pest Management (IPM) program.

Sources of Water in the Soil

The perception exists today, and has for years, that wet greens are almost exclusively caused by overwatering. The thinking is that most golf course superintendents overirrigate on purpose since many golfers like soft greens and overwatering is easier than proper irrigation management. I submit that, like most generalizations, this one is unfair to the many superintendents who irrigate with good common sense. At one time, some years ago, this overwatering criticism may have been true. Today, with greater knowledge, better technology, and an awareness of the problems associated with wet greens, turf managers as a group are more careful than they ever have been in keeping greens as

dry as possible. Good water control is recognized as a major management goal of today's golf course superintendent.

The question is, why do wet greens still occur? In particular, why do they continue to be wet soils on shaded, pocketed greens? To answer this question, the source of water in the soil needs to be examined.

Water in the soil generally comes from two sources, rainfall and irrigation. With golf course superintendents being better attuned to the problems of wet greens, and with the better irrigation systems we have today, the application of water *onto* greens should not be the main source of the problem. Obviously, problems still occur with overwatering, but the fact is, most golf course superintendents try not to overwater greens. They are doing more and more hand watering, especially on poorly drained, pocketed greens. But some years this program is less successful than others. Why? The answer lies with the second source of soil water — rainfall.

All things being equal, problems with greens occur much more often during wet years, especially when the rainfall occurs in conjunction with hot, humid summers. The reason is simple. During dry years, the superintendent has control of the water.



Poor syringing techniques result in poor water control. Runoff should never occur when turf is properly syringed.

When superintendents lose control of water in the greens, their troubles begin. Soils become wet and saturated; they become anaerobic and black layers can form; roots die back; the grass becomes weakened. Then, disease and other problems occur (including algae, brown patch, and damage from various *Pythium* species). In extreme cases, wet wilt can occur. In the meantime, golf continues to be played, the greens continue to be mown, and the soils become compacted near the surface. Problems accelerate as the turf thins, algae invades the voids, and the superintendent loses control of the situation.

Given this potential scenario, most superintendents I know prefer dry years. They simply have better control over the water on their golf course. Superintendents dread wet summers on soils that do not drain. They know that once the soil is wet, it is hard to dry it out. The question is, where does soil water go and how can soils that are wet be better managed?

The Fate of Water in the Soil

Once water has entered the soil, two things can happen to it. They are:

1. Drainage — Excess water moves down through the soil profile.
2. Evapotranspiration — Water is lost into the air from the turf surface through evaporation from the soil and transpiration from leaf surfaces.

It is very important to know and appreciate each of these fates. They are the means by which the golf course superintendent can manage excess water in the soil. Let's look at each one.

1. Drainage

It's an unfortunate fact that the majority of the putting greens in this country do not enjoy anything approaching rapid internal soil drainage. In fact, most golf greens in this country were not built with even a basic system of drain lines, much less on a gravel blanket. They would be characterized as having varying types and depths of soil; many are old-style, clay-based greens whose only salvation is having good surface drainage. And where soil modification may exist, it usually occurs only to the depth of the aeration holes or the topdressing layer.

Also, only a small minority of putting greens have a modified root zone through the entire soil profile down to a gravel blanket or to drainage lines. It is even a smaller percentage of putting greens that are carefully built to any recognized specifications for putting green construction, be they guidelines from the USGA Green Section or elsewhere. This is where most of the problem lies. Even though superintendents might be very careful when irrigating their poorly drained greens, water control is lost when

rainfall occurs or in instances where overwatering does occur. Once wet, these greens remain wet, and when you combine wet soils with hot temperatures, the vicious cycle begins.

2. Evapotranspiration

The loss of soil water by evaporation from the soil and transpiration from plant leaves is termed evapotranspiration. Transpiration is the mechanism by which most of the evapotranspirational water is lost from dense turfgrass stands, including most greens. As much as 80 to 85 percent of soil moisture loss can be attributed to evapotranspiration (Beard, 1973).

The evapotranspiration rate (ET) is a well-known number used by many golf course superintendents when scheduling their irrigation programs. Unfortunately, the amount of water lost through evapotranspiration from a golf course varies from site to site and from green to green. For example, a green located in shade, without good air circulation, will lose much less water from the same soil than an adjacent green located on top of a hill with good air circulation and full sunlight.

It is in situations like this that the experience and expertise of golf course superintendents are tested the most. That is, the management of the amount of water

applied to individual greens. Different management strategies must be employed when irrigating grass on a green in one environment compared to greens in other locations.

On some courses, most greens require separate irrigation programs. Managing these differences remains one of the greatest challenges for today's golf course superintendents. If overwatering of greens occurs today, this is where it can happen. When greens growing in different environments are irrigated according to the same schedule, no doubt some of these greens are being under-watered or overwatered.

If there is an overriding purpose to this article, it is to point out how water reaches the soil and how it then moves out of the soil. Sometimes, I feel we look at each element — irrigation, drainage, and evapotranspiration — as a separate item. In reality, they are intimately associated.

Managing Soil Water

What are the tools available to the golf course superintendent to manage soil water?

1. Irrigation Management

Irrigation is the intentional application of water to the turf and soil. Determining how much water to apply to a given green on a given day is one of the most profound challenges facing a golf course superintendent. If a green has a sandy, modified soil over a gravel drainage blanket with a complete drainage system underneath, the best irrigation program will be different from that practiced on an old-style, clay-based *push-up* green. On these old greens, the only well-draining soil is what has accumulated, over time, through aeration and topdressing.

Managing soil water begins with proper irrigation. Simply appreciating the differences in the soil's ability to drain or hold water is critical to exercising water control, whether it is for a green on top of a hill or under a tree. This is why more and more superintendents are installing separate irrigation systems for their greens and green banks. This is a good way to separate the water needs of a green from those of the surrounding areas, which often require more water than the green surfaces themselves.

More and more greens are being watered by hand. This is a very effective tool for the golf course superintendent. Perhaps there is no better money spent on a golf green than for hand watering. It provides for improved water control, pure and simple. On poorly draining soils or on greens that are shady and have a lower ET rate, try to irrigate on the side of dryness. You can always add more water; it is tougher to remove the excess. These strategies work, at least until it rains!

2. Topdressing

Topdressing is the addition of a better draining root zone material on top of the existing green. A deeper zone of modified soil allows the superintendent to better manage compaction, turf root development, soil water, and drainage, at least to the depth of the modified zone. Many greens on old golf courses have been sufficiently modified by topdressing over the years to drain adequately, especially where surface drainage also is adequate.

Dense trees prevent good air movement and dramatically reduce evapotranspiration from the turf. Greens that hold too much water tend to be problem greens.



3. Aeration

Great strides have been made in soil aeration equipment during the past 10 to 15 years. Machines can now aerate deeper than ever before, produce more holes of different sizes and shapes, and do the job more quickly than ever. We can even aerate soil without complaints from golfers by using solid tines, traditional spikers, or high-pressure water injection.

All of these devices were developed, really, for three purposes:

- 1) to improve water infiltration,
- 2) to relieve soil compaction, and
- 3) to allow holes to be backfilled with a better quality material for improved soil aeration.

This is managing soil water at its best. Good aeration creates pores that provide an avenue for water to move through the soil. Also, aeration is a method of drying out a wet soil once it becomes saturated. Aerating in the heat and humidity of a summer stress period might seem extreme to some, but if it helps to keep a green alive, it is worth it. There is always some risk involved, but using a small coring tine, a solid tine, an old spiker, or a new water injection machine can minimize the risk.

4. Evapotranspiration

Have you ever wondered why the installation of oscillating fans on golf courses is such a rage today? It really is the result of several different, yet interrelated factors. Basically, fans significantly increase evapotranspiration, or the movement of water *out* of the soil. Fans are never installed around a green that is located in complete sunlight and receives good air movement. Fans are only used on pocketed greens that lack good air circulation. They are a mechanical means of increasing evapotranspiration and drying out the soil. Today, fans are one of the newest and best methods available to the golf course superintendent to maintain turf on enclosed, pocketed, and shaded greens.

We all know that one of the major problems facing golf course superintendents today is the difficulty of convincing course officials to cut down trees for more sunlight and better air circulation on pocketed greens. It has been recognized for years that the weakest greens and tees on most golf courses are those located in these areas. People are reluctant to cut the trees, prune limbs, and remove underbrush necessary for good air circulation, sunlight penetration, and a better grass-growing environment. However, they

still expect good grass on these greens. When this occurs, the best option may be a fan, or fans, installed at the green site.

The most-asked questions about the use of fans include:

Will a fan compensate for the lack of sunlight?

No.

Will a fan help move water out of wet soil? Yes.

In fact, a fan could be the golf course superintendent's last opportunity to manage excess water in the soil. It allows a wet green to dry out in situations where the green tends to stay too wet for too long.

Summary and Conclusion

Managing soil water includes providing good surface drainage, whenever possible, to move excess water away from the site.

Managing soil water includes managing the application of irrigation water *onto* the site.

Managing soil water includes providing good aeration and drainage to move water *through* the soil.

Managing soil water includes a good top-dressing program to modify an existing soil with a better-draining material.

And finally, managing soil water includes moving water *out of the soil* via evapotranspiration.

All too often today's golf course superintendent is being indicted, sometimes unfairly, for having wet greens. In reality, in many different situations and in many parts of the country, the superintendent really *does not* control soil water because of excessive rainfall, slow-draining soils, and/or insufficiently built or layered greens built of modified soil.

Whether a putting green becomes overly wet due to rainfall or irrigation, the golf course superintendent must manage the problem. It was the purpose of this article to help the turf manager understand the problem, consider all options, and develop short-, intermediate-, and long-term practices to help manage water in the soil. After all, if you can manage soil water, you can better manage grass growing in the soil. It is when you lose control of soil water that problems develop.

With a good appreciation that managing soil water involves more than just irrigation, programs and procedures can be put into place to solve these problems to produce better grass. If, however, all of these techniques fail to provide reliable turf, the final option for improving your ability to manage soil water is complete reconstruction.

Reference:

Beard, James B. 1973. *Turfgrass: Science and Culture*. Prentice-Hall, Englewood Cliffs, NJ. pp. 658.

If trees can't be removed, a fan is the superintendent's last hope to increase air movement.

