

“Where Do My Roots Go In August?”

Managing the factors you can control, and understanding the rest.

by STANLEY J. ZONTEK

GOLF COURSE superintendents know that roots of bentgrass or bentgrass/*Poa annua* greens shorten and die back each summer. And when conditions become hotter, wetter, and more humid, the roots suffer even more, becoming shorter in length and brown in color. These are not good signs to the turf manager who is attempting to maintain putting greens during the peak-play summer golfing season, when the grass already is subject to mechanical, environmental, and disease stresses. It is the purpose of this article to review the factors that cause root dieback during the summer. By understanding these factors, the golf course superintendent may be able to maintain a better root system during the summer.

Factors Associated With Summer Root Dieback

The following factors are listed in order of relative importance in terms of their effects on roots.

Soil Temperature: Of all the factors that affect the loss of roots of cool-season grasses in the summer, soil temperature is the most significant. Research has shown that when soil temperatures approach 85-87 degrees Fahrenheit at a depth of 2 inches, roots of cool-season grasses begin to lose their ability to absorb water and to cool themselves through transpiration. Nutrients, which help to maintain plant health and proper plant functions, also are less readily absorbed. In fact, that's one of the great differences between cool-season and warm-season grasses — their ability to grow under high air and soil temperatures.

Unfortunately, soil temperature is the factor over which the superintendent has the least control. Nevertheless, a few things can be done to help improve the situation. Preliminary research at Kansas State University suggests that roots die back from the surface, where the soil is the warmest, *not* from the bottom up as common sense would suggest. During the past decade, the use of fans on golf courses

has increased dramatically. One of the more important functions of fans is to cool the turf canopy and the upper soil layer. The use of fans is one way a golf course superintendent can help maintain the health of the grass and its root system during the summer.

The new systems that blow air into a green and, to a lesser extent, suck air through a green, can reduce soil temperature to some extent. In some cases, even a small reduction in soil temperature can make a difference. Research currently sponsored by the USGA may help reveal the value of air injection in reducing soil temperatures.

Mowing Height: All one has to do is look at a scalped plug from a putting green under summer heat stress to appreciate just how critical mowing height can be in determining whether a grass plant survives a hot and humid summer. Low mowing heights are also a trigger for stress-related diseases, such as summer patch (*Magnaporthea poae*) and anthracnose (*Colletotrichum graminicola*).

Although golf course superintendents have the ability to adjust cutting heights, they often are pressured to lower heights to obtain fast green speeds. It has been shown that just a bit more leaf canopy can help keep the surface of the soil cooler and help the grass survive. It is important for golfers to understand that mowing grass too closely during the summer is not a good practice, especially when the turf on the greens is *Poa annua* and/or some of the older bentgrass varieties.

In the final analysis, as it pertains to maintaining ultra-low mowing heights and fast green speeds, the old adage may be worth repeating — slow grass is better than no grass.

Irrigation/Over-Irrigation: Simply put, wet soils become hotter soils because water is a good conductor of heat. Although wet soils may take longer to heat up, they also retain heat for longer periods. Too much soil moisture also is associated with a depletion of soil oxygen, which contributes to root loss problems.

The golf course superintendent can't control how much it rains, but she can control how much water is applied through irrigation! The amount of water in the soil has a major impact on summer root decline. Water replaces soil oxygen and this can lead to anaerobic soil conditions, including black layer. Diseases such as brown patch and *Pythium* also are favored by higher levels of moisture. Longer wet/dry cycles work well on more modern greens that drain. On mineral soils that do not drain as well, lighter, more frequent applications of water are best for maintaining the right balance. During the summer, it is always better to water less . . . it's easier to add more water than to remove an excess, especially in soils that just do not drain very rapidly.

Mechanical Damage: Mechanical injury to the grass affects its ability to survive a hot summer. Replace grooved rollers with solid or section rollers. Use floating-head mowers versus fixed head walk-behind mowers and switch from triplex mowers to walk-behind units. *Do not mow greens when they are too wet*, and defer topdressing, vertical mowing and routine grooming operations until temperatures cool and the grass and its root system are under less stress.

Many turf managers and golfers seem unaware of how much mechanical injury can contribute to the decline of roots during the summer. It is a factor that can be controlled but is too often overlooked.

Nematodes: Nematodes sometimes cause root-loss problems, especially in the more southern parts of the country where bentgrass is grown on greens. It should be emphasized that plant parasitic nematodes occur naturally in most soils. But please, do not dash out to treat all of your greens routinely for nematodes unless there is a demonstrated need for these applications based on soil nematode assays. If a problem exists, know that parasitic nematode problems *seldom occur evenly or equally in all greens*. Hot

spots of nematode activity occur. It takes a good scouting program to identify nematodes as a problem, especially in the central, transitional, and/or more northern regions of our country.

A well-thought-out nematode control effort usually begins by reducing other plant stresses by increasing the mowing height or careful attention to syringing, for example. Nematicides are among the most toxic products applied to golf course greens, and their use can be justified only if a significant problem exists. Nonetheless, when factors are considered that can affect the loss of roots in summer, nematode activity should be mentioned even though control measures may not always be justified.

Disease: Soil-borne diseases like *Pythium* can be placed in the category of only *occasionally* affecting the root system. There has been much con-

fusion over the years about *Pythium* problems on greens during the summer. Keep in mind that *Pythium* is ubiquitous . . . it's always in the soil and is a common inhabitant of grass roots. Nonetheless, many fungicide applications are made to greens in the (sometimes futile) attempt to control this naturally occurring soil problem.

The key questions to ask are: Are these *Pythium* species aggressive parasites actively colonizing healthy, live tissue? Are they non-aggressive parasites living in the upper few inches of soil? Or are they saprophytes? It takes an experienced plant pathologist to tell the difference. In my opinion, many of the *Pythium* root dysfunction and root rot problems identified are secondary in nature and occur on tissue, including roots, that is declining due to other stress-related factors. Although a good preventive fungicide spray program is always a good idea,

keep in mind that chemicals alone will not keep grass alive during the summer. They should be part of an integrated program that includes reasonable mowing heights, lightweight hand mowing, reduced mechanical stress from grooming and topdressing, the use of fans, weekly to biweekly applications of light rates of soluble fertilizers, and avoidance of over-watering.

Grass Type: The ability of species or cultivars to tolerate high soil temperatures varies widely. The roots of all cool-season grasses shorten during the summer to some extent, including the newer varieties that have been developed to better tolerate summer heat stress. The difference seems to be the rate at which roots decline and the ability of a variety to tolerate heat stress, regardless of the depth of its rooting system. This is an important point. Visually, the new heat-tolerant bent-grasses may seem to be performing



Maintaining a good root system throughout the difficult summer months is a critical factor for the turf manager. Soil conditions, mowing height, mechanical damage, and irrigation are just a few factors that impact summer root decline. Soil coring is a necessary management tool to maintain good soil aeration resulting in healthy white roots and a healthier plant.



Nematodes can sometimes be the cause of turfgrass root problems. Deformed, swelled roots with bulbous root tips are an indication of potential nematode damage.

better with more grass on the surface of the green, but they have a similar amount of summer root loss in comparison to other species.

Obviously, *Poa annua* also experiences summer root loss problems, including perennial biotypes. *Poa annua*, by its nature, also has lower tolerance to extended periods of heat. That's why *Poa annua* on greens in the deep South functions as a true winter annual, whereas in the upper Transition Zone we routinely see patches of perennial biotypes of *Poa annua* survive the summer. Grass type does make a difference, be it among bentgrass cultivars or annual and perennial biotypes of *Poa annua*.

Determining how these newer bentgrasses perform under actual conditions of play, in comparison to some of the standard, older bentgrass varieties, is one of the reasons the USGA has built 16 demonstration greens across the United States. Stay tuned — the results should be interesting.

Other Factors

Shade Affects Rooting: Proper root development requires an adequate amount of sunlight. Also, shaded and pocketed greens often are wetter greens. There is less evapotranspiration in the shade than in the sun. Thus, if you water greens equally and do not compensate for open and exposed greens versus pocketed and shaded greens, this can cause problems. A combination of higher soil moisture, higher soil temperatures and additional humidity are major causes for the decline of pocketed greens. Proper water

management is critical to maintaining quality turf in shaded environments.

Fertility: Putting greens need some fertilizer during the summer. Light rates of fertilizer applied in a soluble spoon-feed type of program work well. The grass is never over-fertilized, nor is it under-fertilized. Such programs help to maintain roots, to the extent possible, by allowing the grass to re-grow roots from the stems and crowns. This regeneration of roots is another natural factor that helps the grass survive.

Soil Compaction: Zones of soil compaction and/or layers can be managed via an appropriate soil coring and aeration program. Keep in mind that roots grow through air spaces in the soil. Without good soil aeration, root depth and density will suffer. During the summer, aeration can be achieved using solid or small ¼-inch hollow tines, surface spiking, and high-pressure water aeration. Used properly, these practices can help to maintain roots and even stimulate new root development.

Preemergence Herbicides: Some people may be surprised about how low on the priority list of factors affecting root dieback the use of preemergence herbicides is. Preemergence herbicides may inhibit or delay rooting for several weeks following their application, but these products should have few long-term negative effects on roots in the summer *if applied at the proper time and at the proper rate in early spring*. However, if a preemergence herbicide application is made late in the spring or is applied at an excessive rate, then direct injury could occur.

Furthermore, there could be enough soil residual to inhibit rooting during the late summer/early fall period. Additionally, if one of the long-residual preemergence herbicides is applied to the greens too late in the spring, the residual can affect seed germination during fall overseeding work. Know the residual of your preemergence herbicide and plan accordingly. In some cases, it might be better to skip a pre-emergence herbicide application and rely upon postemergence sprays or even hand weeding.

Growth Regulators: It has been said that growth regulators neither benefit root growth nor significantly inhibit root growth. Nevertheless, know the properties of the products you are using and plan accordingly. One observation is worth offering: be careful of combining growth regulators with fungicides that have growth regulating side effects. For example, the sterol-inhibiting fungicides, or DMIs, have growth regulator activity and can adversely affect greens on a PGR (plant growth regulator) program. There can be an enhanced PGR effect, especially if the summer is particularly hot, humid, and stressful. This enhanced growth regulating effect can take the form of phytotoxicity and delayed recovery from injury.

In Summary

Always work to stimulate root development in the spring and fall. Aeration, balanced fertility, and reasonable mowing heights all contribute to good root growth. Be sure to have adequate sunlight and air circulation. Be careful with the application of pre-emergence herbicides, and be on a good preventive fungicide program. Monitor for plant parasitic nematodes and, where appropriate, consider inter-seeding newer varieties of heat-tolerant bentgrasses into problem greens. All of these programs can contribute to healthier grass and better putting green turf during the summer.

Author's Note

The author would like to extend a special thank-you to Dr. Peter Dernoeden at the University of Maryland for reviewing this article.

STANLEY J. ZONTEK is the Director of the USGA Green Section's Mid-Atlantic Region. Stan has a B.S. degree in Agronomy/Turfgrass Management from Penn State University and joined the Green Section staff in 1971.