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TURFGRASS TRENDS

BENTGRASS MANAGEMENT

Effluent Increases Problems With Bentgrass in the Transition Zone

However, superintendents can take several approaches to handling these potential problems

By Danesha Seth-Carley, Tom Rufty, Dan Bowman, and Lane Tredway

In a previous article (February 2009, "Problems Surface with Effluent Use on Turf in the Southeast"), we began discussing effluent irrigation on golf courses in the southeastern U.S. transition zone. While providing an important irrigation water source, recycled water has recently been associated with a number of problems.

A main driver for the increase in effluent irrigation is the requirement by the Environmental Protection Agency and state regulatory agencies that effluent be dispersed on the landscape to protect surface water quality. This makes good sense, environmentally, as the turfgrass system is a natural filter for the pollutants present in effluent.

But one of the problems is excessive amounts of effluent are often being applied, flooding the soil, damaging the turfgrass and decreasing playability. Heavy, compacted soils and high rainfall in the region contribute to the risk of water overload. Permits for effluent disposal, often the result of negotiations between state regulators and engineers hired by developers, set application limits too high, which puts golf course superintendents in an impossible bind.

We now turn our discussion to another problem with effluent application on golf courses in the transition zone — the sensitivity of bentgrass putting greens. The transition zone is the Southern-most limit for growing bentgrass. With heat and humidity during summer months and the prevalence of fungal diseases, summer bentgrass decline often occurs even with a freshwater supply. Reports from golf courses indicate that effluent increases summer problems with bentgrass and may extend the problems outside of the summer period.

Why is bentgrass in the transition zone sensitive to effluent? The first problem a person thinks about with effluent irrigation in the Southwest is salt toxicity. Recycled water contains soluble salts, many of which are plant nutrients. However, with high evaporation rates in an arid climate, salts can cause leaf burning and accumulate in the rootzone. The situation is very different in the Southeastern transition zone.

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About 40 to 50 inches of rain is common and the rainfall is spread relatively evenly throughout the year. Even moderate rainfall can leach salts from the soil and keep salt levels below damaging thresholds. Also, our analyses of effluent generated by waste treatment plants in the Southeast indicate that the salt content is much lower than that found in the Southwest. Levels in the Southwest can range from 2 to 4 dS/m (a measure of the electrical conductivity of water defined as the salinity or salinity index), while they're generally about 0.3-0.7 dS/m in the transition zone. This difference reflects the naturally lower salt content of the water supply in the eastern United States.

The abundant rainfall and relatively low salinity in the transition zone clearly create a lower risk of salt accumulation in the soil and a lower risk of salinity damage to turfgrasses in the Southeast. The potential for salinity problems is also diminished, of course, by the much lower evaporation rates in the humid environment. Nonetheless, it probably would be foolish to assume that effluent salt toxicity would never be a factor in the transition zone.

Extended summer droughts have occurred in four of the last eight years. Frequent, light irrigation with effluent coupled with high evapotranspiration during summer droughts could lead to salt accumulations in the upper root zone that could damage bentgrass.

Under normal rainfall conditions, the cause for the effluent irrigation problem with bentgrass in the transition zone probably lies in the ecology of the system and the involvement of several factors. Creeping bentgrass has been bred to produce a dense canopy, with rapid growth of new shoots and roots.

The production of biomass below ground and the large microbial population it supports leads to buildup of soil organic matter. Accumulation of organic matter creates the biggest management problem for bentgrass greens in any environment. As a general rule, when organic matter exceeds 3.5 percent to 5 percent by weight, it begins to clog soil macropores, restricting drainage and air exchange in the root zone (Adams, 1986, McCoy, 1992; Murphy et al., 1993).

Furthermore, in the heat of summer, organic matter near the soil surface is degraded to gel-like products that may seal pores and restrict gas exchange (Carrow, 2003).

The continuous use of effluent supplies significant amounts of several nutrients. Depending on the frequency of irrigation and the particular effluent source, as much as a 50 percent to 100 percent increase above the normal amount of nitrogen can be added to a bentgrass green.

In recent experiments, additions of this much extra nitrogen caused greater accumulation of organic matter in the upper soil horizon compared to normally fertilized turf. Additional nitrogen is also likely to stimulate microbial activity (Shi et al., 2007), which increases the possibility of sealing reactions at the soil surface.

The problem of too much soil organic matter leads to a cascade of reactions in the bentgrass system. Whether due to clogging of macropores or sealing at the soil surface, water retention increases and oxygen exchange into the root zone is restricted. As shown by two recent scientific papers, low oxygen conditions in the rootzone invariably result in the bentgrass plant producing roots higher in the soil profile, near the soil surface (Jiang and Wang, 2006; Seth-Carley et al., 2009).

Roots close to the surface are exposed to higher temperatures and greater likelihood of salt toxicity during droughts. Unhealthy roots lead to unhealthy shoots, i.e. summer bentgrass decline.

Salt accumulation in the upper root zone can cause bentgrass damage.

PHOTOS COURTESY: NORTH CAROLINA STATE

Numerous field observations also indicate that effluent use on bentgrass may result in greater susceptibility to pests.

Insects and fungal diseases are a continual problem in the Southeast, and pest problems are acute even with healthy plants. Depressed bentgrass health, coupled with the moist environment, creates the perfect storm for pest infestations (Dernoeden, 2002; Peterson et al., 2004).

Obviously, increased pest pressures lead to more pesticide applications and extra cost.

Handling the situation

Superintendents on courses using effluent water can take several approaches in handling the bentgrass sensitivity problem.

The best approach is to have separate delivery lines feeding irrigation heads for the greens. This allows irrigation of greens with fresh water and avoids mixing with effluent. The split systems are often installed on new golf courses where it's known in advance effluent will be used.

In many situations, a split system isn't an option. Established courses may have irrigation systems that aren't easily modified when effluent is introduced as a water source or new courses may have budget limitations. In those cases, superintendents' main management option is to flush effluent out of existing lines with non-effluent water, and then irrigate the greens.

Many courses use this approach, but flushing adds time to irrigation cycles and exacerbates water overloading on fairways. If effluent is the only water source for a course, superintendents are left with the unenviable approach of adding substantial amounts of effluent during dry periods to flush out salts from the soil horizon. This has the downside of loading the greens with nitrogen and other plant nutrients.

Although the use of effluent in the transition zone may create some problems, we must not lose sight of the important role golf courses can play as effluent dispersal sites.

Effluent is generated through the activities of man. Populations are growing in the Southeastern transition zone, so pressures for effluent dispersal continually increase. Golf courses are ideal sites to dispose of effluent with little threat to water quality.

If effluent problems can be handled effectively, golf course managers have an opportunity to make a major contribution towards environmental stewardship and sustainability.

A problem with effluent irrigation is that excessive amounts of effluent are often being applied, flooding the soil, damaging the turfgrass and decreasing playability.

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