Subsurface Irrigation Offers an Efficient Alternative

By Justin D. Weeaks and Michael A. Maurer

The high plains of Texas has limited rainfall, typically receiving about 18 inches annually. This relatively arid area requires that increased supplemental irrigation be applied to turfgrass and residential landscapes.

Given the lack of natural rainfall, providing more efficient means of irrigating turfgrass is a subject that needs to be addressed, particularly in seeded bermudagrass cultivars.

Using bermudagrass seed can quickly add up to substantial savings in terms of seed cost compared to sod or sprig materials. Labor costs are also reduced as a result of less time in seeding golf courses or residential lawns. Using a subsurface drip irrigation system will also add to the savings by more efficient means of irrigation.

Management with SDI is different from conventional over-the-top irrigation systems.

Subsurface drip irrigation (SDI) users may get as much as a 50-percent reduction in water use compared to conventional irrigation systems while still achieving the same plant growth (Pearce, 1994). When using SDI, runoff is virtually eliminated because water is contained in the soil profile. Runoff is the leading cause of water abuse.

With an efficient method of delivering irrigation water, researchers anticipated that it would be possible to establish seeded bermudagrass using SDI.

A well-designed irrigation system will save time, money and most importantly water. SDI minimizes runoff and overspray by putting water at the site of action, the grass's root zone. By designing a looped grid system, efficiency can become as high as 90 percent to 100 percent (d Hulst, 2000).

Subsurface drip irrigation can save water and reduce runoff potential and help to produce a healthier and aesthetically pleasing turfgrass (Lamont, 1994). However, a golf course's management strategies must be changed when irrigating with SDI. Management with SDI is quite different from conventional over-the-top irrigation systems.

Figure 1. The wetting at each plot was sufficient to see visible wetting patterns on the surface.

Subsurface drip irrigation system

Finding the right subsurface drip irrigation products can be simply a matter of the purchaser going with a preferred brand name in most cases.

Typically, a subsurface drip system consists of polyethylene tubing, fittings, emitters, filters, pressure regulators, valves and gauges, and fertigation or chemical units to deliver liquid fertilizers or other chemicals (Lamont, 1994). The tubing is normally one-half inch in diameter and is equipped with emitters for irrigated areas and blank tubing for looping the system.

The filtration system in any irrigation system is critical and subsurface drip is no exception. When using well water or municipal water that is high in soluble salts, a screen or disc filter should be used. Many times a flush-out valve is also used (Lamont, 1994) to flush out sedimentation that may buildup.

Caution must be taken when selecting drip tape due to root penetration and intrusion of the turfgrass plant into the orifice or emitter. Studies have shown that 10 percent of emitters will be blocked within the first three years if the

Continued on page 54

Figure 2. This plot showed turf establishment shortly after seeding at around two weeks.

Figure 3. This plot showed salinity accumulation at the surface at around 16 weeks.

Continued from page 51

emitters are not protected by some form of chemical means. After four years 60 percent of emitters were blocked, and after five years 95 percent of emitters were blocked. Many emitters have trifluralin, a root-inhibiting chemical, impregnated in the emitter (Pearce, 1994).

Some systems have a filter attached at the valve that has a series of discs that when water passes through a small amount of the chemical is delivered throughout the entire system. Since the drip line is flexible, they are usually flexible enough to deal with changes in ground temperature (Stroud, 1987) and changes in contour and grade.

Another important aspect of the subsurface drip irrigation system is its grid design or layout. Typical spacing is at 12-, 18-, or 24-inch increments between drip lines (Maloney and Wright, 1993). Emitter spacing is available in 12-, 18-, and 24-inch increments.

Seeding bermudagrass using SDI

There has been no research to date that indicates whether seeded bermudagrass can be established by using subsurface drip irrigation. Two field experiments were conducted in 2001 and 2002 at Lubbock, Texas, to determine whether seeded bermudagrass could be established using SDI. The system used irrigation water from local city water.

Installation of the SDI system consisted of three SDI treatments of 12-, 18-, and 24- inch lateral spacing of drip lines. The control treatment consisted of 90-degree pop-up sprinklers. Treatments were replicated four times in a randomized block design.

Emitter spacing was equal to the distance between each later drip tube. Plot sizes were 10 feet. by 10 feet for the first year's study and 15 feet by 15 feet for the second year's study. Re-establishing the research was necessary because of research farm relocation.

Bermudagrass was seeded using a drop-type spreader at the rate of 1.5 pounds per 1,000 square feet. The seed was lightly raked in and irrigation followed. Wetting of each treatment was sufficient to see visible wetting patterns on the surface of the soil (Fig 1). Plots were maintained at a constant level of moisture until germination was noticed.

Weekly visual observations were taken to determine percentage of ground cover. Once a plot obtained 90-percent coverage, it was assumed to be complete coverage. Salinity of soil was also monitored monthly through soil samples and analyses of samples.

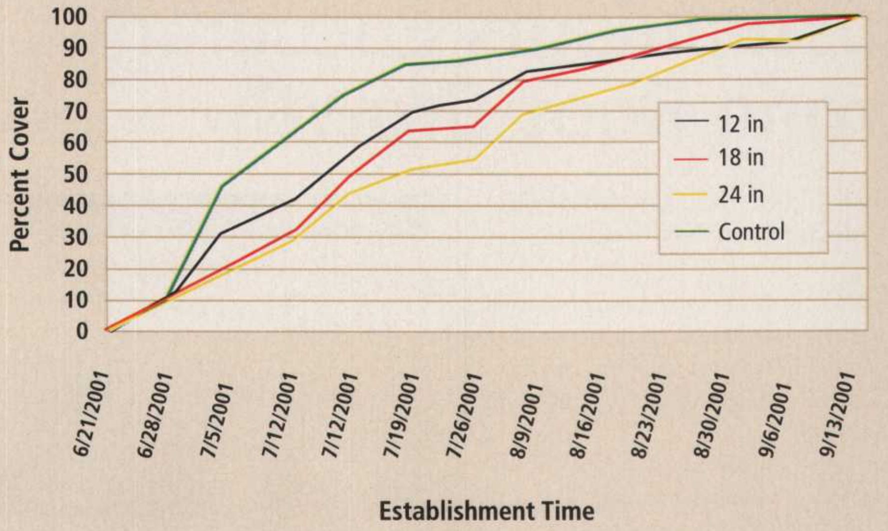
Successful establishment

The primary objective of establishing seeded bermudagrass using SDI was a success. Full (90-percent) turfgrass coverage was noted at weeks 10, 11 and 9 for the 12-, 18-, 24-inch control plots, respectively (Fig. 2). Salinity accumulated in the top 6 inches of the soil for all SDI treatments (Fig. 3).

Although salinity values were elevated in all SDI treatments, there were no deleterious effects on turfgrass quality. A second study was

TABLE 1

Seeded Bermudagrass Coverage



also conducted but that data has not yet been analyzed.

Conclusion

It is possible and practical to establish seeded bermudagrass using SDI. This Texas study obtained acceptable turfgrass coverage in as little as 10 weeks (Fig. 4). This is quite encouraging for superintendents.

This enables an inexpensive alternative to sodding or sprigging, not to mention reduction in labor costs.

Salinity accumulation is a concern that many turfgrass professionals should consider. This study showed there was an accumulation of salinity during the growing season but values returned to pre-study status.

The salinity accumulation during establishment and even a couple of months after establishment is possibly due to very low rainfall during establishment phase.

Even during this period of high salinity values there were no outward signs of turfgrass stress. Once the seeded area received about two inches of rainfall, salinity values decreased significantly. This is very useful in areas that receive little rainfall. More studies need to be conducted on long-term salinity accumulation of SDI tubing.

While we expect seeded cultivars of bermudagrass should establish well when using SDI, turfgrasses such as cool-season fescue and other bunch-type grass may not establish as easily.

This is probably because warm-season grasses have stolons, rhizomes or both to aid in spreading.

Figure 4. These plots showed full coverage in some treatments at around 10 weeks.

However, further studies should be made to confirm or contradict this determination.

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Biostimulants Encourage Strong Root Growth

By Christina Wells, Adrienne LaBranche, L. Bert McCarty and Horace Skipper

Increasingly stringent environmental regulations and negative public perceptions of pesticides and fertilizers have stimulated interest in alternative methods of promoting turfgrass health.

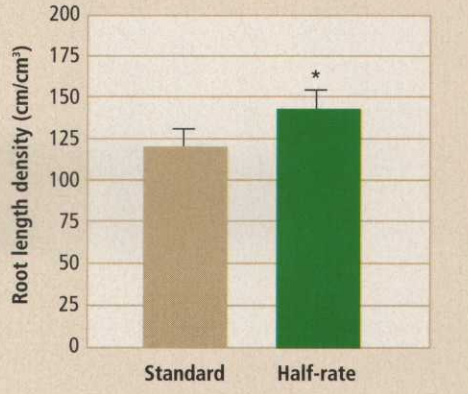
Numerous biostimulant products have emerged, many of them promising better turf quality and stress tolerance, even under conditions of reduced pesticide and fertilizer inputs. The variety of ingredients in these products is remarkable (Karnok, 1993). In most cases, the primary ingredients in biostimulant products have proved beneficial to plant growth in controlled laboratory and/or greenhouse experiments. Whether these same benefits will be consistently obtained under real-world conditions on the golf course is an unanswered question.

One ingredient common to many biostimulant products is seaweed extract. While the idea of applying seaweed to turfgrass may seem far-fetched, many studies attest to the potential for seaweed extract to improve plant growth. Seaweed extracts are rich in micronutrients and often exhibit auxin-, cytokinin-, and/or giberellin-like activity. In addition, they may contain chelating compounds such as mannitol that can increase soil micronutrient availability.

The application of seaweed extract has been shown to increase seed germination, root growth, yield and cold hardiness in a variety of crop plants (Verkleij, 1992). In fact, during the 17th to the early 20th centuries, seaweed was used extensively in coastal areas as a means of maintaining soil productivity.

Humic substances are another common component of biostimulant products. Humic substances are complex mixtures of high molecular weight organic compounds that result from the decomposition of animal and vegetable matter. They can be extracted from a variety of materials, including coal, peat and leonardite (an oxidized form of coal), and their exact chemical composition varies depending on the material from which they were extracted (MacCarthy et al. 1990).

FIGURE 1



This chart shows the mean root length density (cm/cm3) in monthly soil cores taken from plots receiving standard or half-standard nitrogen fertilization. Data from all sampling dates and OPGS treatments are combined.

Many decades of lab experiments on crop plants indicate that the use of humic substances as media amendments or foliar sprays can promote greater root and shoot growth; root branching; leaf chlorophyll content; and rates of nutrient uptake, photosynthesis and respiration (Chen and Aviad, 1990). However, the physiological mechanisms underlying these benefits are poorly understood. Humic substances do appear to possess auxin-like activity, but the specific chemical fractions responsible for this activity have not been identified.

Do positive results in lab studies on crop plants justify applying seaweed extract and humic substances to turf? Some recent studies suggest the answer is a cautious "yes."

Liu and Cooper (2000) recently demonstrated that a granular humate application increased root growth and iron uptake by field-grown creeping bentgrass, although there was no improvement in visual quality. Zhang and Schmidt (2000) reported greater root and shoot

Continued on page 58

TABLE 2

OPGS treatment	Month					
	Apr	May	Jun	Jul	Aug	Overall
Control	82[a]	212[a]	152[a]	108[a]	96[a]	121[a]
Full foliar	71[a]	217[a]	149[a]	128[a]	82[a]	93[a]
Half Foliar	62[a]	192[a]	141[a]	95[a]	90[a]	117[a]
Double Foliar	61[a]	283[b]	158[a]	141[a]	92[a]	150[a]
Granular	82[a]	236[ab]	154[a]	97[a]	101[a]	120[a]

Here's the mean root-length density in monthly soil cores taken from plots receiving five OPGS treatments. Cores were taken from the top 10 cm of soil and contained 7.8 cm^3 total soil volume. Data from standard and half-rate fertilizer programs are combined. Within a column, means followed by different letters are significantly different.

Continued from page 56
growth, improved leaf water status, and higher levels of antioxidants when greenhouse-grown tall fescue and creeping bentgrass were treated with seaweed extract and humic substances.

In light of the research outlined above, we investigated whether the application of an organic plant growth stimulant (OPGS) to a bentgrass green would maintain commercially acceptable turf quality under reduced nitrogen fertilization. Given that both humate and seaweed extract have been reported to promote root growth, we hypothesized that treated turf would have a larger root system capable of more efficiently intercepting applied nitrogen.

Testing products on bentgrass

We tested the effects of fertilization and OPGS on visual turf quality and root growth at Clemson University's Walker GC nursery. The nursery consists of a Crenshaw bentgrass green built to USGA greens specifications in Clemson, S.C.

We used a split-plot experimental design with nitrogen fertilizer level as the main plot factor and OPGS treatment as the subplot factor (Table 1). Foliar OPGS was applied biweekly from April through August using a backpack sprayer. Granular OPGS was applied once in April using a drop spreader and watered in after application. All treatment combinations were replicated three times.

The OPGS products we used were Plant N.O.G. concentrate (foliar) and Seaumic granules (granular), both manufactured by Senn, Sharman and Senn (Clemson, S.C.). The foliar product included both *Ascophyllum nodostum* seaweed extract and homogenized humic substances. Biochemical analyses indicate that it contains .01 percent cytokinin (kinetin) by weight.

The granular product consisted of humate granules encapsulated in a quick-release coating of the foliar OPGS product. The OPGS coating dissolves immediately upon watering, while the humate granule decomposes more gradually after application.

During the 2002 season, we assessed turf quality and root growth in our experimental plots. Monthly turf quality ratings were based on a numerical scale from 1 (dead) to 10 (ideal) and were based on color, vigor and leaf density. Monthly root growth data were collected by measuring the root-length present in three soil cores (3.9 inches deep, with 3 cubic inches of soil volume per core) taken from random locations within each subplot. Roots were washed free from each soil core and scanned on a flatbed color scanner. Total root-length was measured using WinRhizo software (Regent Instruments, Quebec). Data from three cores per subplot were averaged on each sampling date.

There were no significant differences in turf quality among any of the experimental treatments. Turf quality was high throughout the experiment, regardless of nitrogen fertilization rate or OPGS treatment. While the Walker Course typically applies 6 pounds of nitrogen per 1,000 square feet per year to its bentgrass nursery green, our results strongly suggest these rates could be halved without appreciable reduction in turf quality. The OPGS did not significantly influence turf quality, either under the standard or the half-rate fertilization program.

Root-length density was significantly greater in plots that received half the standard nitrogen fertilization rate (Fig. 1). This result is not surprising: Lower rates of nitrogen application have long been known to encourage turf root growth.

A double-strength foliar OPGS application also significantly increased root-length density on one sampling date during the experiment (Table 2). Granular OPGS and lower rates of foliar OPGS had no significant effects on root-length density on any date. In general, root-length density reached a seasonal peak in May and dropped continually thereafter (Fig. 2).

Our data suggest that OPGS treatment promoted root-length production only during the May period of maximum root growth. We will continue this research to determine whether similar seasonal trends occur in subsequent years.

Management implications

Our study showed that OPGS products can influence turfgrass root growth under real-world conditions when applied at high rates. However, the lack of influence of OPGS treatment on turf visual quality leads us to question whether the products were truly cost-effective.

Under conditions of heavy foot traffic or greater environmental stress, the increase in rooting due to OPGS treatment may have translated into healthier turf and higher visual quality ratings. In our nursery green, however, the turf experienced relatively little stress and turf quality ratings were consistently high. Under these conditions, OPGS application may not be warranted.

Our work suggests two points to bear in mind when considering OPGS application: (1) OPGS treatment may be most beneficial on sites where root growth is known to be the primary factor limiting turf performance; and (2) OPGS treatments may be most effective when applied early in the season when roots are actively growing. Biostimulant products are not cure-alls. But with continued research it's likely that they will find a place in environmentally friendly turf-management programs.

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Back to Life in the Bronx

A full-time superintendent and the First Tee are just what the doctor ordered for Mosholu GC

BY LARRY AYLWARD, EDITOR

Click-clack. Click-clack. Click-clack.

The crowded subway train glides swiftly along the track through a tattered section of the Bronx. It sways subtly from side to side unbeknownst to its seasoned riders, many who stare expressionless out the train's windows at the seemingly never-ending row of run-down and graffiti-stained tenements.

You can almost hear the weathered brick faces of the buildings groan in despair as the train travels past them. Indeed, this section of New York's famous borough appears bruised and battered.

Click-clack. Click-clack. Click-clack.

"The next and last stop is Woodlawn," a monotone voice announces on the train's public-address system.

Mosholu's first tee is a short wedge shot from the Bronx's No. 4 subway line.

A few moments later, the clicks and clacks diminish as the train decelerates and coasts into the dark station. Woodlawn is the end of the line for the No. 4 train.

Upon rising from your seat to vacate the halted train, you see *it* from the left row of windows. *It* is hard to believe, really.

Where did *it* come from? How did *it* get here in the midst of this crowded, concrete jungle?

To the first-time visitor, Mosholu GC looks a little out of place. But the nine-hole course is a wonderful thing to see in the thick of the bustling Bronx.

It's amazing to think that Mosholu has been here since 1914. It's even more amazing to think how much the city-owned course has improved in the past year. After all, Mosholu had been left for dead only about two years ago.

The course was dirty, ugly and neglected then. Overgrown tree branches surrounded its crabgrass-infested greens. Its tees and fairways hadn't been aerified in 10 years. Heck, the course didn't even employ a superintendent.

But what a comeback Mosholu has made under the auspices of New York's finest — from the city's golf industry, that is. Mosholu is not the most spectacular facility in the New York area — far from it. But the 3,100-yard course has found a new and important purpose for its existence.

Mosholu is the first course in the metropolitan New York area to become a member of the First Tee program, which was formed