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Effects of Drip Irrigation and Cultivation Methods on Establishment of Seeded Tall Fescue[1]

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Summary

Subsurface drip irrigation (SDI) is becoming increasingly popular for maintaining turfgrass, in part because it conserves water. However, turf managers considering SDI may wonder if SDI is effective in establishing seeded turfgrass, should the need arise. Also, can verticutting or core aeration be used to establish the seedbed without damaging the buried driplines? Is one of those two cultivation methods better than the other? These questions were evaluated in this study. An aboveground drip irrigation system (AGD) was also evaluated because it has been suggested as a portable method for establishing turfgrass planted along roadsides.

Results indicated seeded tall fescue [*Schedonorus arundinaceus* (Schreb.) Dumort.] turf was successfully established with SDI in fine-textured soil in a transition zone climate. Seeded turf established faster with SDI than AGD or overhead sprinkler irrigation. With SDI, establishment was faster when water was applied 2× than 3× or 1× per day (the same amount of water per day was applied in each, but was split into one, two, or three applications). Core aerification and verticutting for seedbed preparation were equally successful in establishing seeded tall fescue using SDI. Buried driplines were not damaged under the conditions of this study, but depths of cultivation and driplines must always be considered to avoid SDI damage.

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Rationale

Subsurface drip irrigation directly applies water to the soil/root interface using pressure-compensating driplines buried in the soil, resulting in less water loss through evaporation, wind drift or runoff than with overhead sprinkler methods. To date, most SDI research in turfgrass has been conducted in sandy loam soils in the semi-arid, southwestern U.S., and has indicated that turf maintained with SDI was similar to or even better than plots maintained with traditional overhead sprinklers (Leinauer et al., 2010; Schiavon et al., 2015; Serena et al., 2014; Suarez-Rey et al., 2000). Such research using SDI in other climates and in fine-textured (silt- or clay-based) soils is lacking.

If SDI is to be installed in lieu of overhead sprinkler systems, one important consideration is to evaluate the effectiveness of using SDI in the establishment of turfgrass from seed, but only a few studies have investigated this. Aboveground drip irrigation (AGD) is similar to SDI except that it rests on the soil surface (Figure 1), and has been suggested as a portable system to enhance the establishment of turfgrass along roadsides. However, little research has been conducted to evaluate the use of AGD in the establishment of turfgrass (Watkins et al., 2020).

Preparation of the seedbed with cultivation (for example, core aeration or verticutting) is an important consideration when establishing turfgrass. In SDI systems, cultivation has the potential to damage buried driplines if cultivation is deep enough to nick or penetrate them. To our knowledge there has been no research regarding the effects of cultivation prior to seeding on turfgrass establishment when using SDI.

Irrigation frequency and the amount of water applied at each irrigation affects the distance that water moves upwards and laterally away from the buried driplines in SDI. This water movement may determine the successful convergence of wetting fronts at the surface between the driplines, as well as whether the surface is maintained wet enough to facilitate turfgrass seed germination.

Research is needed to investigate these factors, including water amounts, irrigation frequency, and cultivation methods when using SDI to establish turfgrass in fine-textured soils. Our goal in this study was to determine if SDI and AGD could effectively establish cool-season turf from seed comparably to conventional overhead irrigation in fine-textured soils in the transition zone of the U.S.

Objective

To investigate establishment of seeded tall fescue using:

1. SDI and AGD compared with overhead sprinklers; and
2. core aeration vs. verticutting for seedbed preparation.

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Study Description

This study was conducted in fine-textured soils in the transition zone of the U.S. at the Rocky Ford Turfgrass Research Center near Manhattan, KS, from October 1 to November 1, 2019, and September 24 to October 26, 2020. Glyphosate (Glyphomate 41, PBI/ Gordon Corporation) was applied to existing turfgrass three weeks before seeding in each establishment experiment; after the turf turned brown, all dead biomass was removed with a sod cutter. Tall fescue, which is a popular turfgrass for lawns in the transition zone (Bremer et al., 2012), was seeded to the study area at a rate of 8 lb/1000 ft^2, using a shaker bottle in multiple directions, and seed was incorporated using a leaf rake to ensure good seed-to-soil contact. The tall fescue seed blend included the cultivars 'Copious' (38.67% purity), 'Reunion' (38.56% purity), and 'Starfire II' (22.27% purity) (All Pro Transition Blend, Lesco Inc.). The study area was then covered with a 0.5-ounce polyester mesh frost protection blanket (DeWitt Company) to prevent seed movement during potential heavy rain events (Figure 2). The cover was removed when shoots began to appear, which was approximately one week after seeding on October 6 in 2019, and September 30 in 2020, to avoid damage to seedlings when covers were removed. The covers were effective in preventing erosion of seed on plots during rainfall, which prompted a spinoff study to investigate the use of covers in spring seed establishment (Bach et al., 2021). In this study, the tall fescue was not mown and weeds were removed by hand.

The dripline in both SDI and AGD was pressure-compensating dripline (Techline Dripline, Netafim) buried at 6 inches and spaced 18 inches apart. Water was applied at a rate of 0.7 ounces per minute and treatment application amounts were measured with water meters (WM-200-10-RS, Netafim). The only difference between AGD and SDI was that AGD was a new system that rested on the soil surface, while the SDI had been installed several years earlier and was buried in the soil. Distribution uniformity for the overhead sprinkler zone was 75% prior to the trial in each year, as determined with catch-device audits.

Irrigation was applied daily at 150% of reference evapotranspiration (ET_o) as follows: 1) SDI, three times daily (SDI 3×; ~0800, 1300, and 1700 h CST, 50% ET_o each application); 2) SDI, two times daily (SDI 2×; ~0800 and 1700 CST, 75% ET_o each application); 3) SDI, once daily (SDI 1×; ~1300 CST, 150% ET_o each application); 4) AGD, three times daily (50% ET_o each application); and 5) traditional overhead sprinklers (I-20 gear-drive rotors, Hunter Industries) (3× daily, 50% ET_o each application). On the day before seeding, two cultivation treatments were applied to the split plots including: 1) core aeration (Toro 588 ProCore aerifier, The Toro Company); and 2) verticutting (Billy Goat power rake, Briggs & Stratton). Core aeration removed 0.5-inch diameter cores measuring approximately 3 inches deep and spaced 3 inches apart. The additional frequencies/amounts included with SDI were due to the unknown of how soil hydraulic conductivity would impact uniformity of surface wetting and seed germination.

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The experiment was arranged in a split-plot complete block design with irrigation treatments applied to whole plots and cultivation treatments applied to split-plots within whole plots. Five irrigation treatments were each represented by a single irrigation zone (20 by 40 ft), with each zone divided into four whole plots (10 by 20 ft). Within each whole plot, two cultivation treatments were randomly applied to subplots (10 by 10 ft) for a total of 40 subplots (eight in each irrigation zone) in the entire study.

Establishment was evaluated with green cover measured with digital images (Nikon D5000, Nikon Inc.) using a lighted camera box, visual turfgrass quality ratings, and ground and drone-based measurements of normalized difference vegetation index (NDVI).

Results

Our results demonstrated that tall fescue turfgrass can be established from seed with SDI in fine-textured soil in a transition zone climate. Interestingly, establishment was generally better in all SDI treatments than in AGD or the traditional overhead sprinklers, based on measurements of green cover (Figure 3; see Bach et al. (2022) for turf quality and NDVI). By the end of the first month after seeding, green cover and NDVI were up to 25% and 15% greater, respectively, in SDI than AGD and overhead sprinklers. Furthermore, SDI 2× at 75% ET replacement per irrigation consistently established tall fescue faster than SDI 3× at 50% ET per irrigation and, to a lesser degree than SDI 1× at 150% ET, which demonstrates the importance of proper irrigation frequency and amounts per irrigation in fine-textured soils when establishing turfgrass from seed with SDI.

Cultivation method did not affect green cover, turf quality, NDVI, or soil moisture, which indicates that either core aerification or verticutting cultivation techniques could be used to prepare the seedbed prior to seeding when establishing turfgrass using SDI. Seedbed preparation with either method is appropriate as long as depths of cultivation and driplines are considered to avoid SDI damage. Although aeration at a 3-inch depth (as in this study) would not be expected to damage an SDI system buried at a 6-in. depth, this research confirmed it to be safe.

Our results generally indicated poorer establishment with AGD than with SDI. Regardless, AGD was similar to overhead sprinklers and may be suitable for portable roadside irrigation during the establishment of seeded turfgrass where no other irrigation is available, as has been recommended by others (Watkins et al., 2020). More research is needed to evaluate the establishment of turfgrass using AGD, including the effects of different irrigation amounts and frequencies. Nevertheless, our results indicate that where SDI is available, it is preferable to AGD in the establishment of turfgrass from seed under the conditions of our study.

Additional details from this study are available in Bach et al. (2022).

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Figure 1. Aboveground drip irrigation system. In this study, driplines were spaced at 18 inches and rested on the soil surface. The subsurface drip irrigation driplines were nearly identical but were buried in the soil at 6 inches.

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Figure 2. The entire plot area was covered with a polyester mesh cover immediately after seeding, primarily for erosion control. Covers were removed after emerging seedlings began to appear through cover, about one week after seeding.

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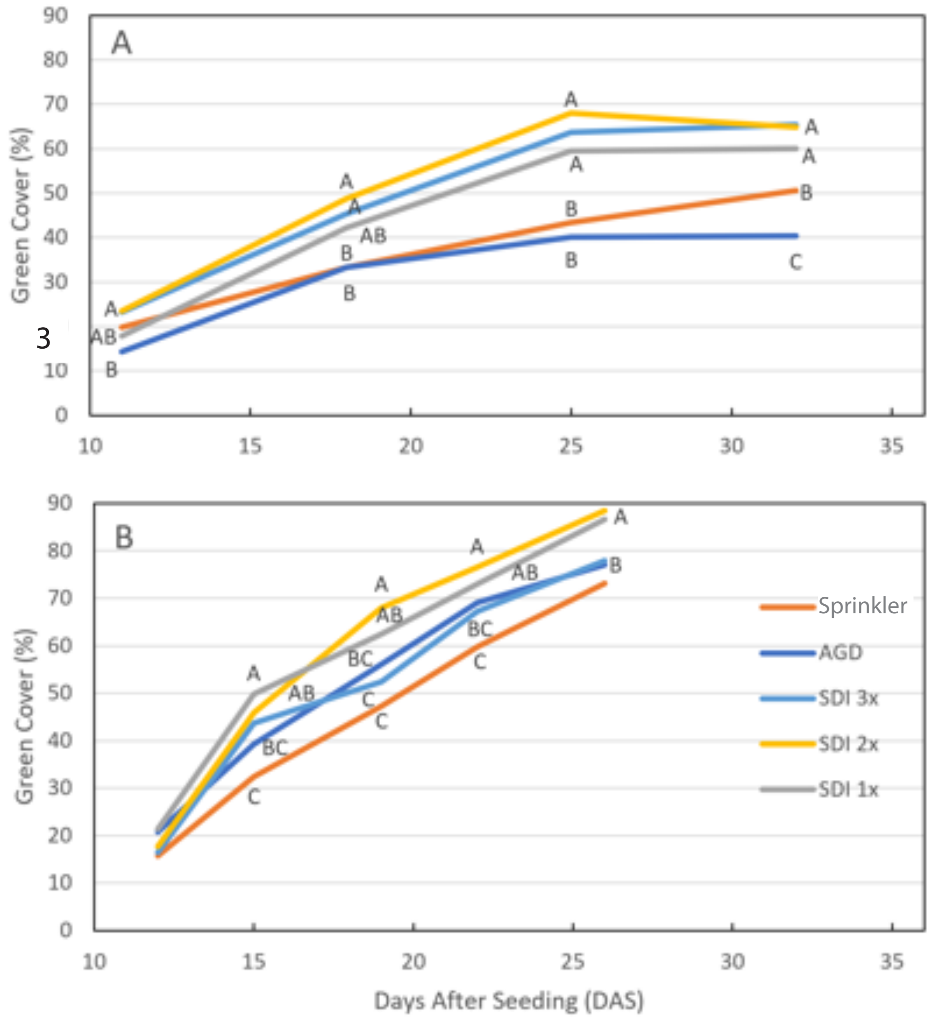

Figure 3. Percentage green cover among irrigation treatments during (A) 2019 and (B) 2020. Treatments included overhead sprinkler, aboveground drip (AGD), subsurface drip irrigation (SDI) applied three times per day (SDI 3×), SDI applied twice per day (SDI 2×), and SDI applied once per day (SDI 1×). On each measurement date, means with the same letter are not significantly different at $\alpha = .05$.

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