Establishment of Roadside Turfgrasses with Modular Irrigation Systems

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Introduction

The University of Minnesota has been working with the Minnesota Department of Transportation (MNDOT) and the Local Road and Research Board for over five years developing and implementing salt-tolerant grasses for use on roadsides that receive deicing salts in the winter. The result of this collaborative effort has been the introduction of salt-tolerant sod mixtures, primarily fine fescues, that are certified by the Minnesota Crop Improvement Association and grown by local sod producers (Friell et al., 2013). Through on-site assessments, we have determined that even with the use of these improved mixtures, there are an unacceptably high number of installation failures due mainly to post-installation watering. Current watering practices (water trucks) are insufficient for fine fescue sod and new options need to be identified and implemented in a way that makes economic sense for MNDOT and sod/seed installers.

Irrigating with a water truck is costly, time-consuming and inefficient. A recent salt-tolerant sod installation in Minnesota of 13,378 square meters received 1,567,160 liters of water over a 10-day period, which was all done with a water truck (personal observation). This equates to filling a 11,360 liter water truck 138 times. This is likely more water than is necessary, and we observed that the majority of the water was applied at a very high volume with much of water running off the site prior to penetrating into the soil. To provide a healthy turfgrass system, irrigation must be able to infiltrate the surface within a reasonable time and hold water within the active rootzone (Leinauer and Devitt, 2013). When transplanted, sod has a shallow root system meaning this active rootzone is much smaller and needs more consistent and efficient watering methods.

It is clear that water trucks, as they are currently utilized, do not provide the type of watering that is needed to efficiently establish salt-tolerant turfgrasses. Many urban sod and seed installations have fire hydrants or other water sources close by; this may provide an option for using alternative watering methods that are more effective and economical. The use of modular irrigation systems connected to fire hydrants will likely increase the success of seed and sod establishment and reduce costs associated with water trucks.

Objectives

1. To investigate the potential of irrigating new roadside turfgrass establishments through the use of onsite fire hydrants and modular irrigation systems.
2. To determine the most effective modular irrigation system that will both reduce the cost of irrigating roadsides and improve the success of establishment.

Materials and Methods

- The study was conducted on two roadside boulevards in St. Paul, MN for separate 60-day establishment periods. Location 1 was a 5-ft wide boulevard on Larpenteur Avenue between Cleveland and Gortner Avenues. Location 2 was a 11-ft wide boulevard along Como Avenue between Fifield and Gibbs Streets (Figure 1). Plot length was 15 feet.
    - Location 1 was initially installed on May 19th, 2016 and irrigated for until July 19th, 2016.
    - Location 2 was initially installed on July 1st, 2016 and irrigated for a until August 29th, 2016.
- The study was designed as a randomized complete block with three replications and treatments applied to both seeded and sodded plots. Seeded plots were planted with MNST-12 salt-tolerant mixture (80% fine fescue and 20% Kentucky bluegrass) at a rate of 245 kg ha^{-1} and covered with erosion control blanket. Sodded plots were planted with MNST-12 sod harvested and planted on the same day.
- Treatments included:
    - 12” x 12” drip tape style irrigation placed BELOW sod or to a 12 mm depth in soil for seed
    - 12” x 12” drip tape style irrigation placed ABOVE sod or at the soil surface for seed
    - 18” x 18” drip tape style irrigation placed BELOW sod or to a 12 mm depth in soil for seed
    - 18” x 18” drip tape style irrigation placed ABOVE sod or at the soil surface for seed
    - Overhead irrigation with MP Rotator (Hunter Irrigation)
    - Unirrigated control
- Watering regime: irrigation volumes were programmed based on observed soil moisture requirements. On the day of planting, 4mm of irrigation was applied in two separate cycles. For the 10-day period following planting, both seed and sod treatments were irrigated with 4mm of water 2x per day for a daily total of 8mm and a weekly total of 54mm. Days 11-30, seed and sod were irrigated with 4mm per day (28mm weekly), and days 31-60 irrigation was applied every other day at 4mm (12mm to 16mm weekly). The study was designed such that seed and sod treatments were required to be irrigated for the same frequency and duration due to combine control valves.
- Plots were evaluated for:
    - Volumetric water content (TDR 300, Spectrum Tech): 12 measurements per plot to 4.8 inches
    - Seedling germination: 1-9 scale, 9 = best
    - Percent turfgrass cover: 0-100%
    - Percent weed: 0-100%
    - Turfgrass quality: 1-9, 9 = best
    - Percent green tissue: 0-100%
- The study area was fertilized at a rate of 25kg N, 50kg P_2O_5 and 25kg K_2O ha^{-1} prior to planting.
- Data were analyzed using ANOVA with Agricultural Research Manager (ARM, Gylling Data Management Inc., Brookings, South Dakota) with Fisher’s Protected LSD at $\alpha = 0.05$.

Table 1. Precipitation rate, maximum length of run and price per hectare for both 12” and 18” drip tape style irrigation. Netafim 630 series drip tape with emitter rate of 0.98 L/hr at 15 psi.

Drip tape	Row and emitter spacing	Precip. rate (mm/hr)	Maximum length (meters)	Price per hectare
Netafim streamline	12”x12”	10.6	190	$3,945.00
Netafim streamline	18”x18”	4.7	248	$2519.00

Results and Discussion

System costs
One of the main concerns of roadside sod and seed establishment is the cost associated with irrigation. Labor required for irrigation with water trucks can exceed $5,000 per hectare in 30 days. Modular irrigation systems can reduce costs and increase the number of successful establishments. Drip irrigation spacing will impact the cost for initial setup and systems with wider spacing will cost less (Table 1). Additional costs will be required for purchasing reusable components such as valves, timers and pressure regulators. Our most expensive system costs less than $10,000 per hectare and can likely be reused five or more times.

Irrigated sod
Above sod drip irrigation systems were sufficient to maintain acceptable quality of MNST-12 sod throughout the 60-day trial period (Table 2). The greatest ratings for green tissue and quality were achieved with the 12”x12” drip irrigation design placed above sod, followed by 18”x18” above sod systems. Below sod drip systems provided intermediate quality, while the overhead irrigation design received the lowest quality ratings of the irrigated treatments. The poor performance of the below sod drip systems can be attributed to lack of turf quality and rooting of sod directly above the drip tape (Figure 2). The unirrigated control treatments did not produce acceptable establishment and the sod appeared to be dead approximately 5-6 days after planting.

Irrigated seed
Surprisingly, irrigation treatments did not provide significantly better turfgrass cover for MNST-12 seeded plots (Table 3). Overall, turfgrass cover did not exceed 55% for any treatment at both locations following the 60-day irrigation period. The lack of response from irrigated seed treatments is likely due to the limitation in study design prohibiting seed treatments from being irrigated differently than sod treatments; seed and sod irrigation systems were operated on the same valve and frequency and rate were constant. Seeded roadsides likely require greater frequency and less volume of watering than those that are sodded.

Overhead systems
Overhead irrigation systems increased the success of sod establishment compared to the unirrigated control, but not seed establishment. While the overhead systems are likely an improvement from water trucks, significant overspray resulted in wasted water and a negative visual perception of this practice.

Table 2. Turfgrass sod quality as affected by irrigation treatment at two locations in St. Paul, MN.

Treatment	Location 1	Location 2
	Turf quality (55 DAP*)	Turf quality (57 DAP)
12” above	7.0 a	7.3 a
12” below	5.0 b	6.7 ab
18” above	6.0 ab	7.3 a
18” below	6.0 ab	6.0 bc
Overhead	5.0 b	5.3 c
Unirrigated	1.0 c	3.0 d
P-value	0.0008	0.0002

*DAP= days after planting

Table 3. Percent turf cover from seeded plots as affected by irrigation treatment at two locations in St. Paul, MN.

Treatment	Location 1	Location 2
	Percent turf (77 DAS*)	Percent turf (57 DAS)
12” above	55.0%	33.3%
12” below	56.7%	33.3%
18” above	46.7%	20.0%
18” below	51.7%	28.3%
Overhead	43.3%	30.0%
Unirrigated	38.3%	18.3%
P value	NS	NS

*DAS= days after seeding

Figure 1. Location 2 trial area and example of fire hydrant connection

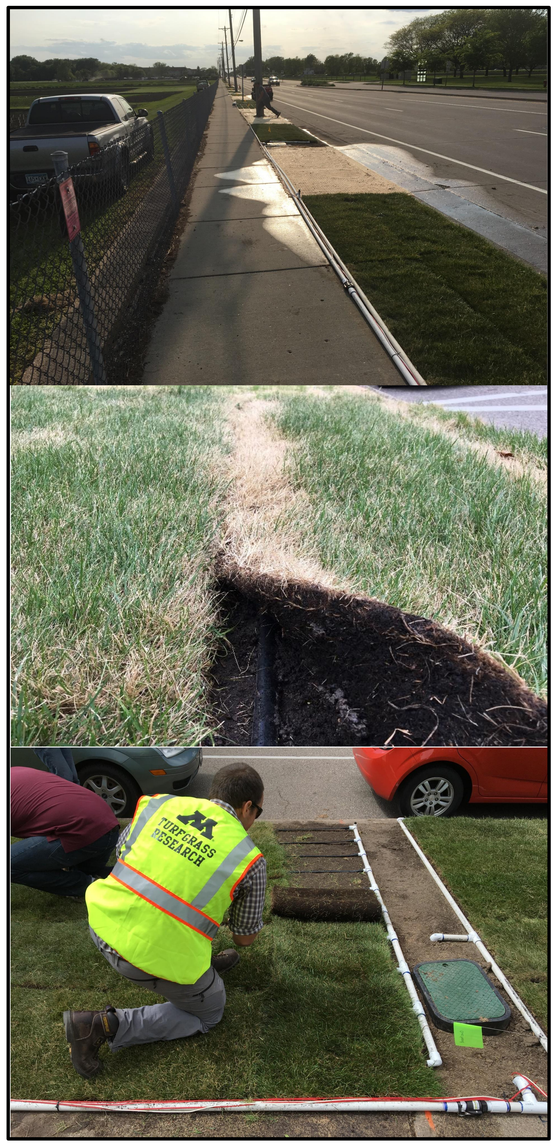

Figure 2. Overhead and below sod drip systems

Conclusions

- It is very practical to irrigate both seed and sod on boulevards and roadsides with modular drip or overhead irrigation systems connected to fire hydrants, resulting reduce costs from water trucks and more successful establishments.
- Above sod drip irrigation systems provided the best turf quality and spacing was not always a factor. Greater spacing will reduce installation costs.
- Seed establishment was not improved by the use of modular irrigation and this is likely attributed to the frequency and rate of irrigation applied.
- Overhead irrigation systems are impractical from a water conservation and public perception standpoint.

Literature Cited

Friell, J., E. Watkins, and B. Horgan. 2013. Salt-tolerance of 74 turfgrass cultivars in nutrient solution culture. Crop Sci. 53:1743-1749.

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