Evaluation of Cool-Season Turfgrass Species Mixtures for Roadsides

Joshua Friell, Eric Watkins, Brian Horgan, and Maggie Reiter
University of Minnesota, St. Paul, Minnesota 55108
frie0250@umn.edu
website: http://www.turf.umn.edu

Introduction

- Mowed turfgrass is, and will continue to be, a part of the solution for creating roadsides that are both functional and sustainable
- In cold weather climates, high salt loads from road deicing practices necessitate the use of salt-tolerant turfgrasses
- Use of multi-species assemblages is known to improve overall performance of turfgrass stands
- Identification of mixtures capable of long-term persistence on roadsides in cold-weather climates is necessary

Objectives

1. Assess roadside survival ability of turfgrass mixtures containing salt-tolerant cultivars
2. Evaluate the effect of individual species on the performance of each mixture
3. Identify spatial trends in survival of roadside plantings

Materials and Methods

Mixtures

- A total of 9 species were used, with cultivars previously evaluated for salt tolerance and roadside use[1,2](Table 1)
- 51 mixtures of cool-season turfgrasses were defined, each containing 3 to 6 species with a maximum of 40% for any one species (Table 2)
- Mixtures were defined using *adxxvert* and *proc optex* in SAS software

Species	Cultivar
Strong creeping red fescue (STCRF) *Festuca rubra ssp. rubra*	Navigator
Alkaligrass (ALK) *Puccinellia spp.*	Salty
Kentucky bluegrass (KBG) *Poa pratensis* **L.**	MoonlightSLT
Creeping bentgrass (CBG) *Agrostis stolonifera* **L.**	Mariner
Sheep fescue (SHF) *Festuca ovina* **L.**	MarcoPolo
Hard fescue (HF) *Festuca trachyphylla* **(Hack.) Krajina**	Beacon
Slender creeping red fescue (SLCRF) *Festuca rubra ssp. litoralis*	Shoreline
Tall fescue (TF) *Festuca arundinacea* **Schreb.**	Grande II
Chewings fescue (CHF) *Festuca rubra* **L.** *ssp. fallax* **(Thuill.) Nyman**	TCP (Radar)

Table 1. Top-performing cultivars previously evaluated for salt tolerance and roadside use

Figure 1. Pictures from the St. Paul (top) and Centerville (bottom) roadside sites in summer 2012

Mixture	STCRF	ALK	KBG	CBG	SHF	HDF	SLCRF	TF	CHF
1							0.20	0.40	0.40
2						0.40		0.40	0.20
3					0.20			0.40	0.40
4					0.20	0.40	0.20		0.20
5					0.40		0.40	0.20	
6				0.20		0.40			0.40
7				0.20		0.40	0.40		
8				0.40			0.40		0.20
9				0.40	0.40				0.20
10				0.40	0.40			0.20	
11			0.07	0.07	0.40	0.40	0.07		
12			0.20				0.40		0.40
13			0.20			0.40			0.40
14			0.20	0.40		0.20	0.20		
15			0.40			0.20		0.40	
16			0.40			0.20	0.40		
17			0.40	0.07		0.40	0.07	0.07	
18			0.40	0.07	0.40		0.07	0.07	
19			0.40	0.20					0.40
20			0.40	0.20			0.40		
21		0.07		0.07	0.40			0.07	0.40
22		0.07	0.07	0.40				0.40	0.07
23		0.20			0.40			0.40	
24		0.20			0.40		0.40		
25		0.40						0.20	0.40
26		0.40					0.40	0.20	
27		0.40				0.40			0.20
28		0.40				0.40		0.20	
29		0.40		0.40		0.10	0.10		
30		0.40	0.20		0.40				
31		0.40	0.40	0.07	0.07		0.07		
32	0.10			0.40				0.10	0.40
33	0.12			0.12	0.12	0.12	0.12	0.40	
34	0.20						0.40	0.40	
35	0.20			0.40		0.40			
36	0.20		0.40					0.20	0.20
37	0.20		0.40	0.40					
38	0.20	0.20	0.20	0.20	0.20				
39	0.20	0.40						0.40	
40	0.33	0.33					0.33		
41	0.40					0.40	0.20		
42	0.40				0.20		0.40		
43	0.40			0.20		0.20			0.20
44	0.40			0.40			0.20		
45	0.40		0.07		0.40		0.07	0.07	
46	0.40		0.20					0.40	
47	0.40		0.40			0.20			
48	0.40	0.20							0.40
49	0.40	0.20				0.20		0.20	
50	0.40	0.40			0.20				
MnDOT		0.20	0.60				0.20		

Table 2. Mixture identification and constituent species proportions

Experimental Design and Establishment

- In fall 2011, sites were sprayed with RoundUp and Momentum FX herbicides to kill existing vegetation, soil was tilled, and a starter fertilizer was applied at a rate of 27.4 kg N ha^{-1}, 21.5 kg P ha^{-1}, and 49.6 kg K ha^{-1}
- 3 replications were seeded at each of 2 roadside sites: 1) Larpenteur Ave (St. Paul, Minnesota)—a four-lane divided urban street; and 2) Hwy 14 (Centerville, Minnesota)—a two-lane rural highway (Fig. 1)
- Mixtures were seeded at a rate of 2 pure live seeds cm^{-2} and plots were covered with Futerra seeding blankets to prevent erosion and washout

Figure 2. Depiction of range of roadside performance in the roadside mixture trial at St. Paul in spring 2012

Data Collection and Analysis

- Digital images were collected for each plot at both roadside mixture sites with a custom-built light box in spring 2012 and summer 2012
- Images were analyzed for percent green tissue using a custom script written in Image Processing Toolbox (MATLAB) to identify the percent of the ground area covered in green plant tissue
- Data was combined, arc-sin transformed, and fit with a linear mixed-effects model for spring 2012 (Fig. 3) and summer 2012 (Fig. 4) using The R Project for Statistical Computing
- The grid intersect method was used to determine percent cover of living turfgrass and grid coordinates of surviving plants in spring 2013
- Grid count data were analyzed using multiple linear regression and spatial analysis was conducted using binomial regression in The R Project for Statistical Computing (Fig. 5)

Results

Spring 2012

- The top 3 mixtures (5, 8, and 24) all contained 40% slender creeping red fescue and maintained a maximum of 61.5% green ground cover
- Mixtures 29, 30, 31, and a mixture developed using recommendations from the Minnesota Department of Transportation were found to be the worst-performing in the trial, and these mixtures contained 40% alkaligrass in combination with large proportions of either Kentucky bluegrass or creeping bentgrass

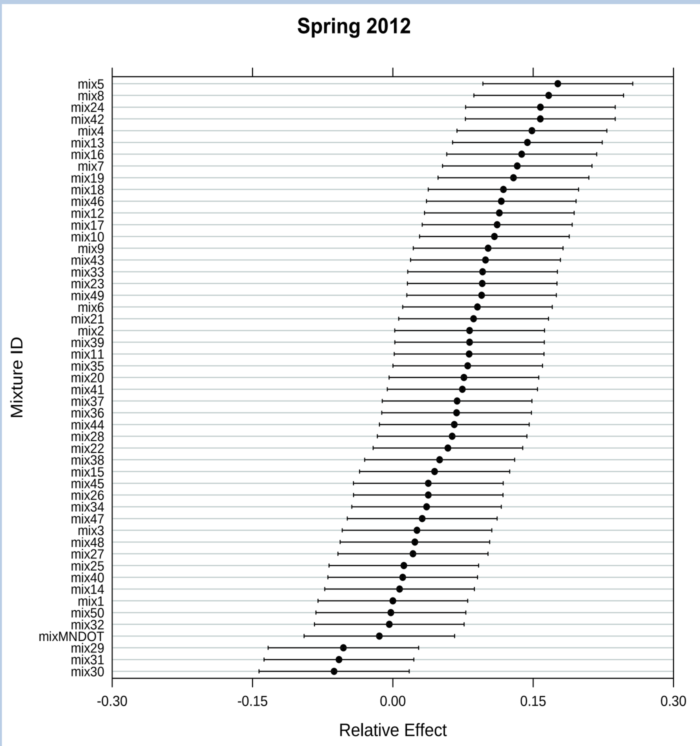

Figure 3. Regression coefficients from final model of the percent cover data from spring 2012 in the roadside trial

Summer 2012

- The top 3 performing mixtures (17, 10, and 5) contained distinct species from one another and thus reveal no obvious trend; however, each of them included the maximum 40% of one of the fine fescue species
- Tall fescue was often the primary living turfgrass

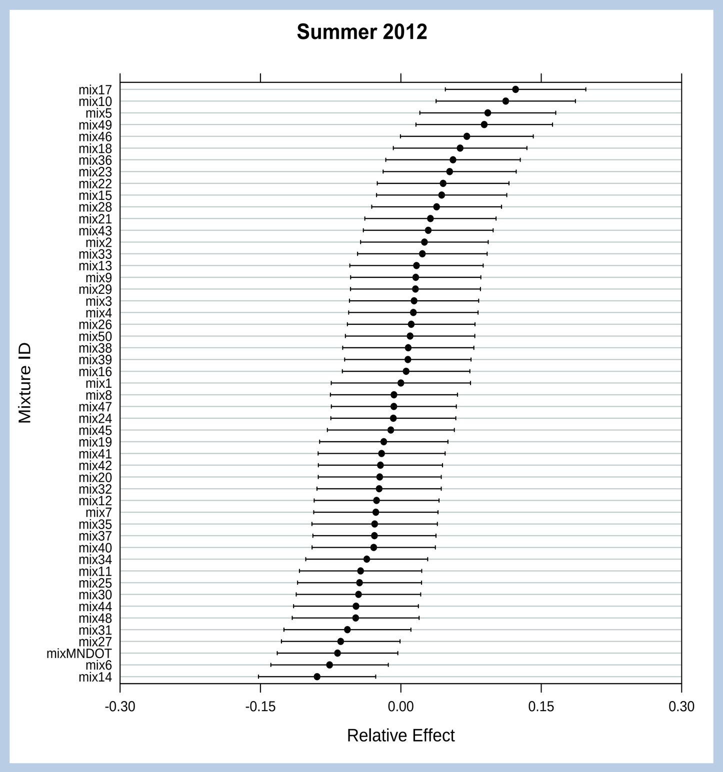

Figure 4. Regression coefficients from final model of the percent cover data from summer 2012 in the roadside trial

Spring 2013

- The top 4 mixtures (7, 16, 18, and 14) all contained slender creeping red fescue and maintained a maximum of 45.8% green ground cover
- None of the best mixtures included significant proportions of tall fescue
- Grid-intersect data showed a significant and site-dependent effect of distance from the road on the probability of retaining living turfgrass cover (Fig. 6)

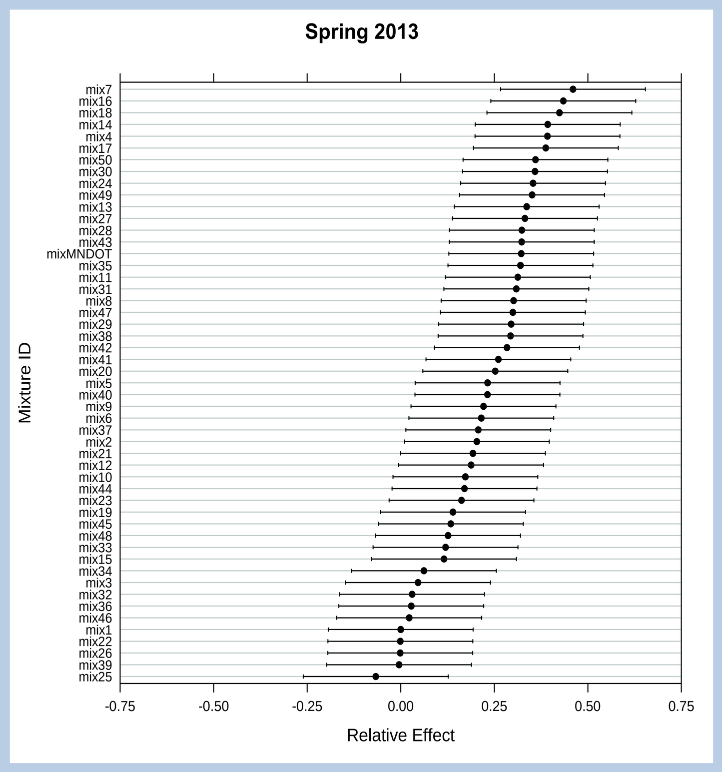

Figure 5. Regression coefficients from final model of the percent cover data from spring 2013 in the roadside trial

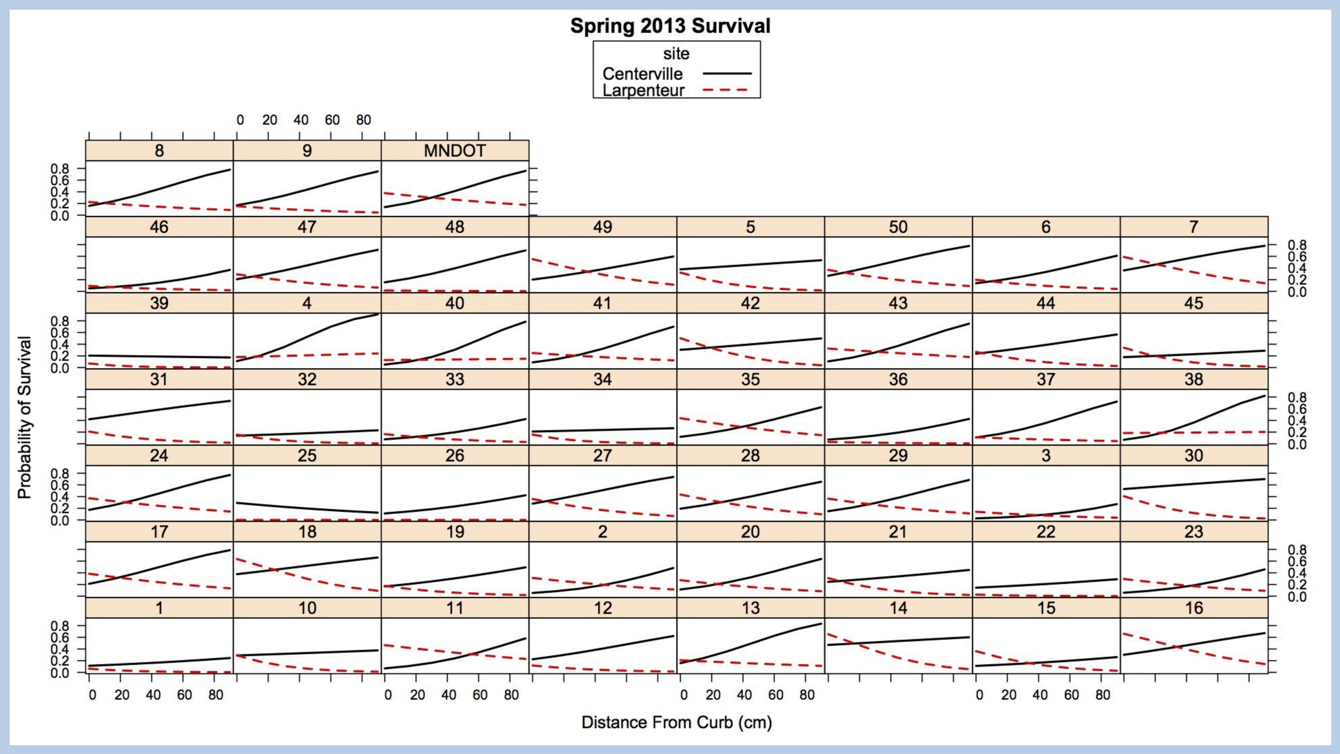

Figure 6. Spatial trends analysis for survival in the roadside turfgrass experiment

Conclusions

- Mixtures 4 and 5, which included several fine fescues and some tall fescue, were identified as being the most persistent
- Mixtures containing large proportions of Kentucky bluegrass, creeping bentgrass or alkaligrass did not perform well
- Mixtures with tall fescue showed best summer performance, but did not survive well into spring 2013 likely due to winter ice cover
- Overall, mixtures containing fine fescues along with small amounts of tall fescue and Kentucky bluegrass exhibited greatest promise for survival on roadsides
- Spatial analysis revealed survival vs. distance from road differs by site, indicating potential topographical effects on survival
- Long-term fluctuation in environmental conditions demonstrates the necessity for including multiple species in a mixture with each species possessing a unique stress tolerance

References

1. Friell, J., E. Watkins, and B. Horgan. 2012. Salt tolerance of 75 cool-season turfgrasses for roadsides. Acta Agriculturae Scandinavica 62:44-52.
2. Friell, J., E. Watkins, and B. Horgan. 2013. Salt tolerance of 74 turfgrass cultivars in nutrient solution culture. Crop Science 53:1743-1749.

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