

Application to: State of Minnesota Department of Transportation		
TITLE OF PROJECT: Developing salt-tolerant sod mixtures for use as roadside turf in Minnesota		
Is this a Response to a specific MN/DOT need? ☐ Yes ☐ No If yes, state name of contact person at MN/DOT:	Date Received:	Work Order Number:
APPLICANT ORGANIZATION: Name: Regents of the University of Minnesota Address: Sponsored Projects Administration McNamara Alumni Center 200 Oak Street SE, Suite 450 Minneapolis, Minnesota 55455-2070 DUNS #: 55-591-7996	TYPE OF ORGANIZATION: State Educational Institution State ID: 8029894 Federal Tax ID: 41-6007513 Congressional District:	
PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR: Name (Last, first, middle): Watkins, Eric, Degree(s): Position/Title: Department: Horticultural Science Major Subdivision: FOOD, AGRI/NAT RSRC SCI, COLL		
Mailing Address (Street, city, state, zip code): Horticultural Science Room 338 AlderH 6008 St Paul, MN 55108 Tel: 4-7496 Fax: E-Mail: ewatkins@umn.edu		
INITIAL BUDGET PERIOD: From: 07/01/2010 Through: 06/30/2011 Initial Budget Period Cost (\$): 44,593		TOTAL PROJECT PERIOD: From: 07/01/2010 Through: 06/30/2014 Length: 48 Months Total Project Period Cost (\$): 176,516
ADMINISTRATIVE CONTACT: Name: Brett Carlson Title: Senior Grant Administrator Address: Sponsored Projects Administration 200 Oak Street SE McNamara Alumni Center, Suite 450 Minneapolis, Minnesota 55455-2070 Telephone: (612) 626-7441 Fax: (612) 624-4843 E-Mail: carls234@umn.edu	OFFICIAL FOR AUTHORIZED SIGNATURE: Name: E.Wink/K.McKoskey/J.Krzyzek/D.Hagen Title: Assoc. VP/Sr. Grants Mgr/Grants Mgr/Asst.Dir. Address: Sponsored Projects Administration 200 Oak Street SE, Suite 450 Minneapolis, Minnesota 55455-2070 Telephone: (612) 624-5599 Fax: (612) 624-4843 E-Mail: awards@umn.edu	
I agree to accept responsibility for the scientific conduct of the project pursuant to University Policy and to provide the required progress reports. Willful provision of false information is a criminal offense. I am aware that any false, fictitious or fraudulent statement may subject me to civil penalties under the Program Fraud Civil Remedies Act of 1986 (45 CFR 79)	Signature of Principal Investigator _____ Date _____	
Reviewed by _____ Date _____ Center for Transportation Studies	Signature of Official Named _____ Date _____	

PROJECT ABSTRACT:

The current Mn/DOT recommendation for salt resistant sod (Table 3878-1) is in need of re-evaluation. Recently, a number of sod installations conforming to the Mn/DOT specifications have failed. It is critical that additional grass species and cultivars are evaluated under high-salt conditions so that the best salt-tolerant sod can be produced. Several species that are not currently included in the recommendations have performed well in low-input turfgrass evaluations in Minnesota and should be evaluated for salt tolerance in roadside environments. The goal of the proposed research is to develop a recommended mixture or a set of mixtures that provide salt-tolerant sod by utilizing the most recently-developed turfgrass cultivars. We propose a three-year research sequence consisting of three primary research objectives. The first objective will determine the most salt-tolerant cultivars within several turfgrass species in multiple roadside environments (including shade). The second objective will evaluate several mixtures in both roadside salt tolerance trials and on-farm sod evaluations using the top-performing cultivars from objective 1. The third objective will quantify water use of the mixtures used in objective 2 so that the environmental benefits of salt-tolerant turfgrass mixtures can be communicated to users and stakeholders.

KEY PERSONNEL:

Name	Organization	Role on Project
Watkins, Eric,	University of Minnesota	Prin. Investigator
Hollman, Andrew, Brian	University of Minnesota	Co-Investigator
Horgan, Brian, P	University of Minnesota	Co-Investigator

KEY WORDS:

salinity, turf, native, low-input, water-use, evapotranspiration, sod, roadside

IMPLEMENTATION:

What methods, procedures, products, and/or standards should change as a result of this research project?

1. We will provide revised specifications for MnDOT projects that require salt-tolerant turfgrass. This will be of great benefit to public agencies that are charged establishing roadside vegetation. 2. This research will lead to a better understanding of roadside vegetation establishment methods (seeding, sodding, etc.). 3. Sod growers will be better informed about low-input, salt-tolerant turfgrasses and how they can be effectively grown as sod. This low-input sod can have uses beyond roadside vegetation (rain garden buffers, sloped areas, public parks and schools, etc.). 4. Along with a pilot salt-tolerant sod certification program, our research will ensure that public agencies are purchasing a product (sod) that will work in the situation for which it is intended (roadsides). 5. Because we are testing in multiple locations, we will be able to provide information about species and mixture performance on varying soil types. This will be valuable as public agencies attempt to determine which grasses to use on individual sites. 6. Research results will be communicated to professional audiences at the Northern Green Expo and the Minnesota Erosion Control Conference. 7. Results will be published in scientific peer-reviewed journal articles. This will show the scientific community the impact of this work. 8. The water-use research will help to identify mixtures of grasses that can be used in drought-susceptible sites on both public and private land. This could significantly decrease landscape water use in Minnesota and other states.

What are the specific benefits of this change(s)? Why would this change(s) be important and how can these benefits be measured?

This research will benefit Mn/DOT and local municipalities by presenting them with the best possible mixture of salt-tolerant grass species based on currently-available cultivars and unbiased research results. A well-established turf comprised of species that have improved salt tolerance will be beneficial both environmentally (less inputs, reduced need to re-establish, soil stabilization, reduced erosion, higher quality storm water runoff) and economically (time and money savings for re-establishment of failed projects, reduced cost of inputs, economic benefits for the sod industry, etc.). This combination of environmental and economic benefits provides a clear rationale for use of public dollars for this type of research.

Project Title: Developing salt-tolerant sod mixtures for use as roadside turf in Minnesota					
DETAILED BUDGET FOR THE INITIAL BUDGET PERIOD				From 07/01/2010	Through 06/30/2011
PERSONNEL: (Applicant Organization Only)	Type Appt (months)	Effort Mths on Project	Dollar Amount Requested (omit cents)		
Name / Role			Salary Requested	Fringe Benefits	Totals
Watkins, Eric Prin. Investigator	9	0.09(0.5)	3,546	714	4,260
Hollman, Andrew Brian Co-Investigator	12	1.8	7,304	2,702	10,006
Horgan, Brian P Co-Investigator	12	0.12	0	0	0
TO BE NAMED Graduate Assistant	12	9	16,280	12,047	28,327
Personnel Totals:			27,130	15,463	42,593
CONSULTANT COSTS:					
Consultant Totals:					0
EQUIPMENT:					
Equipment Totals:					0
SUPPLIES: (Itemize by category) Supplies for test plots (years 1-2) (\$1,500);					
Supply Totals:					1,500
TRAVEL: Domestic, in-state travel (\$500);					
Travel Totals:					500
OTHER EXPENSES:					
Other Expense Totals:					0
CONSORTIUM/CONTRACT COSTS	Direct Costs				0
	Indirect Costs				0
TOTAL DIRECT COSTS FOR THE INITIAL BUDGET PERIOD					44,593
TOTAL INDIRECT COSTS FOR THE INITIAL BUDGET PERIOD					0

Project Title: Developing salt-tolerant sod mixtures for use as roadside turf in Minnesota					
DETAILED BUDGET FOR THE SECOND BUDGET PERIOD				From 07/01/2011	Through 06/30/2012
PERSONNEL: (Applicant Organization Only)	Type Appt (months)	Effort Mths on Project	Dollar Amount Requested (omit cents)		
Name / Role			Salary Requested	Fringe Benefits	Totals
Watkins, Eric Prin. Investigator	9	0.09(0.5)	3,652	735	4,387
Hollman, Andrew Brian Co-Investigator	12	1.2	5,015	1,855	6,870
Horgan, Brian P Co-Investigator	12	0.12	0	0	0
TO BE NAMED Graduate Assistant	12	9	16,931	12,529	29,460
Personnel Totals:			25,598	15,119	40,717
CONSULTANT COSTS:					
Consultant Totals:					0
EQUIPMENT:					
Equipment Totals:					0
SUPPLIES: (Itemize by category) Supplies for test plots (years 1-2) (\$2,500);					
Supply Totals:					2,500
TRAVEL: Domestic, in-state travel (\$750);					
Travel Totals:					750
OTHER EXPENSES:					
Other Expense Totals:					0
CONSORTIUM/CONTRACT COSTS	Direct Costs				0
	Indirect Costs				0
TOTAL DIRECT COSTS FOR THE SECOND BUDGET PERIOD					43,967
TOTAL INDIRECT COSTS FOR THE SECOND BUDGET PERIOD					0

Project Title: Developing salt-tolerant sod mixtures for use as roadside turf in Minnesota					
DETAILED BUDGET FOR THE THIRD BUDGET PERIOD				From 07/01/2012	Through 06/30/2013
PERSONNEL: (Applicant Organization Only)	Type Appt (months)	Effort Mths on Project	Dollar Amount Requested (omit cents)		
Name / Role			Salary Requested	Fringe Benefits	Totals
Watkins, Eric Prin. Investigator	9	0.09(0.5)	3,762	757	4,519
Hollman, Andrew Brian Co-Investigator	12	1.44	6,199	2,293	8,492
Horgan, Brian P Co-Investigator	12	0.12	0	0	0
TO BE NAMED Graduate Assistant	12	9	17,608	13,030	30,638
Personnel Totals:			27,569	16,080	43,649
CONSULTANT COSTS:					
Consultant Totals:					0
EQUIPMENT:					
Equipment Totals:					0
SUPPLIES: (Itemize by category)					
Supply Totals:					0
TRAVEL: Domestic, in-state travel (\$501);					
Travel Totals:					501
OTHER EXPENSES:					
Other Expense Totals:					0
CONSORTIUM/CONTRACT COSTS	Direct Costs				0
	Indirect Costs				0
TOTAL DIRECT COSTS FOR THE THIRD BUDGET PERIOD					44,150
TOTAL INDIRECT COSTS FOR THE THIRD BUDGET PERIOD					0

Project Title: Developing salt-tolerant sod mixtures for use as roadside turf in Minnesota					
DETAILED BUDGET FOR THE FOURTH BUDGET PERIOD				From 07/01/2013	Through 06/30/2014
PERSONNEL: (Applicant Organization Only)	Type Appt (months)	Effort Mths on Project	Dollar Amount Requested (omit cents)		
Name / Role			Salary Requested	Fringe Benefits	Totals
Watkins, Eric Prin. Investigator	9	0.09(0.5)	3,874	780	4,654
Hollman, Andrew Brian Co-Investigator	12	1.2	5,321	1,968	7,289
Horgan, Brian P Co-Investigator	12	0.12	0	0	0
TO BE NAMED Graduate Assistant	12	9	18,312	13,551	31,863
Personnel Totals:			27,507	16,299	43,806
CONSULTANT COSTS:					
Consultant Totals:					0
EQUIPMENT:					
Equipment Totals:					0
SUPPLIES: (Itemize by category)					
Supply Totals:					0
TRAVEL:					
Travel Totals:					0
OTHER EXPENSES:					
Other Expense Totals:					0
CONSORTIUM/CONTRACT COSTS	Direct Costs				0
	Indirect Costs				0
TOTAL DIRECT COSTS FOR THE FOURTH BUDGET PERIOD					43,806
TOTAL INDIRECT COSTS FOR THE FOURTH BUDGET PERIOD					0

Project Title: Developing salt-tolerant sod mixtures for use as roadside turf in Minnesota					
DETAILED BUDGET FOR THE ENTIRE BUDGET				From 07/01/2010	Through 06/30/2014
PERSONNEL: (Applicant Organization Only)	Type Appt (months)	Effort Mths on Project	Dollar Amount Requested (omit cents)		
Name / Role			Salary Requested	Fringe Benefits	Totals
Watkins, Eric Prin. Investigator	9(2)	0.36(2)	14,834	2,986	17,820
Hollman, Andrew Brian Co-Investigator	12	5.64	23,839	8,818	32,657
Horgan, Brian P Co-Investigator	12	0.48	0	0	0
TO BE NAMED Graduate Assistant	12	36	69,131	51,157	120,288
Personnel Totals:			107,804	62,961	170,765
CONSULTANT COSTS:					
Consultant Totals:					0
EQUIPMENT:					
Equipment Totals:					0
SUPPLIES: (Itemize by category) Supplies for test plots (years 1-2) (\$4,000);					
Supply Totals:					4,000
TRAVEL: Domestic, in-state travel (\$1,751);					
Travel Totals:					1,751
OTHER EXPENSES:					
Other Expense Totals:					0
CONSORTIUM/CONTRACT COSTS	Direct Costs				0
	Indirect Costs				0
TOTAL DIRECT COSTS FOR THE ENTIRE BUDGET					176,516
TOTAL INDIRECT COSTS FOR THE ENTIRE BUDGET					0

BUDGET JUSTIFICATION - Developing salt-tolerant sod mixtures for use as roadside turf in Minnesota

***** BUDGET NUMBER JUSTIFICATIONS *****

Year 1: \$32,546 x 0% = 0

Year 2: \$31,438 x 0% = 0

Year 3: \$31,120 x 0% = 0

Year 4: \$30,255 x 0% = 0

Justification - MNDOT rate is 0% (state agency)

Total To Apply F&A Rate = Total Direct Costs - Total Backed Out Costs

125,359 = 176,516 - 51,157

Total F&A Costs = 0

Total Costs = Total Direct Costs + Total F&A Costs

176,516 = 176,516 + 0

Future years recurring costs have been calculated using a % inflation rate, unless noted otherwise in the item justification.

Base salaries listed are for the current University appointment. Calculation of the amount of salary requested in each budget period includes inflation effective July 1 of each fiscal year, prorated to the budget period, and adjusted if appointment is less than 100%. If this award is reduced, effort obligations and proposed cost sharing (matching or in-kind) will be reduced proportionately.

FISCAL YEAR	ACADEMIC	CIVIL SERVICE
2011	32.30%	37.00%
2012	32.30%	37.00%
2013	32.30%	37.00%
2014	32.30%	37.00%
2015	32.30%	37.00%

GRADUATE/PROFESSIONAL TRAINING STUDENTS FRINGE RATES:

Fringe varies by individual based on percent of time appointed and the number of credits.

***** BUDGET SETUP JUSTIFICATION(S) *****

Future years recurring costs have been calculated using a 3% inflation rate, unless noted otherwise in the item justification.

Justification - MNDOT rate is 0% (state agency)

***** BUDGET PERSONNEL JUSTIFICATION(S) *****

Watkins, Eric , Principal Investigator

- Summer salary for PI (Dr. Watkins). PI will coordinate project, provide initial cultivar and species lists, develop mixtures for all projects, assist with evaluating research plots, present research findings to Mn/DOT and other organizations, and develop new acceptable cultivar lists for Mn/DOT salt-tolerant sod specifications based on University of Minnesota data.

Hollman, Andrew Brian, Co-Investigator

- Andrew Hollman (Scientist for Turfgrass Research Program) will assist with seed acquisition, plot preparation, plot establishment, data collection, and data analysis.

TO BE NAMED, Graduate Assistant

- One graduate student will be funded through this grant. The graduate student will be responsible for assisting in experimental design, seed acquisitions, establishment and plot rating, etc. The students will also conduct salt-tolerant mixture water-use research on the St. Paul campus.

***** SUPPLIES JUSTIFICATION(S) *****

Supplies for test plots (years 1-2)

- Funds will be used to purchase germination blankets and seed for all trials and software for digital image analysis (Sigma Scan). Digital image analysis will be used for drought-stress evaluations and to quantify turf damage from salt.

***** TRAVEL COSTS JUSTIFICATION(S) *****

Domestic, in-state travel

- Funds will be used for travel from campus to the three off-site locations and the sod farm.

PROJECT DETAILS - Developing salt-tolerant sod mixtures for use as roadside turf in Minnesota

BACKGROUND:

In 2004, a regional research project was initiated to evaluate a wide range of species for suitability at an extremely low level of management (no supplemental irrigation, fertilizer or pesticide inputs following establishment). The research group evaluating the Low Input Sustainable Turfgrass (L.I.S.T) study included turfgrass scientists from Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio, Iowa, South Dakota, and North Dakota. The study included a number of species that are not commonly used as turfgrass in Minnesota or other parts of the region.

In Minnesota, species that performed well with monthly mowing at various mowing heights under these low-input conditions included hard fescue (*Festuca brevipila*), sheep fescue (*Festuca ovina*), tall fescue (*Schedonorus phoenix*), colonial bentgrass (*Agrostis capillaris*), tufted hairgrass (*Deschampsia cespitosa*), and prairie junegrass (*Koeleria macrantha*). Similar results were found at other locations. Another fine fescue species, Chewings fescue (*Festuca rubra* L. ssp. *fallax*), has performed very well in multiple lower-input turf trials in Minnesota (see www.turf.umn.edu).

These projects all indicate that there may be suitable species for use in salt-tolerant sod that are currently not being utilized by Mn/DOT; however, none of these studies evaluated these grasses in roadside conditions in Minnesota. Research results from roadside testing are critical to the development of worthwhile salt-tolerant sod recommendations.

OBJECTIVE:

The goal of the proposed research is to develop a recommended mixture or a set of mixtures that provide salt-tolerant sod by utilizing the most recently-developed turfgrass cultivars. We propose a three-year research sequence consisting of three primary research objectives. The first objective will determine the most salt-tolerant cultivars within several turfgrass species in multiple roadside environments (including shade). The second objective will evaluate several mixtures in both roadside salt tolerance trials and on-farm sod evaluations using the top-performing cultivars from objective 1. The third objective will quantify water use of the mixtures used in objective 2 so that the environmental benefits of salt-tolerant turfgrass mixtures can be communicated to users and stakeholders.

SCOPE:

Obj. 1: In fall 2010, trials will be established at 3 sites in the Twin Cities Metropolitan Region. Each trial will consist of at least 75 cultivars or selections representing multiple turfgrass species including grasses that do well in both sun and shade environments. Each trial will be a randomized complete block design with four replications. Plots will be planted next to roads in order to provide realistic pressure from salt damage. Data will be collected from fall 2010 through fall 2011 and will include both qualitative (salt damage, quality, color, disease incidence, density, recovery from salt damage, etc.) and quantitative (electrical conductivity to determine salt content of soil, digital image analysis for determining salinity stress, desired species counts, weed counts and plant density) data. Data will be analyzed and used to assemble mixtures for further testing (objective 2).

Obj. 2: Data from objective 1 will be used to develop 25 seed mixtures that will be tested in 3 roadside tests as in objective 1; however, data collection will continue for two years. The same mixtures will be tested in a trial at a sod-farm for sod-forming ability.

Obj. 3: The same 25 mixtures will be evaluated for water use.

LITERATURE SEARCH:

In addition to recent low-input turfgrass evaluation trials conducted in Minnesota (Watkins et al., 2008), researchers from the north central region of the United States have evaluated traditional and non-traditional turfgrasses for use in low maintenance areas for the past 15 years (Diesburg et al., 1997). Results from these studies indicate that sheep fescue and tall fescue are best adapted across the entire region.

Unfortunately, these and other studies were not conducted under high-salt, roadside conditions. Limited research is available on cool-season turfgrass salinity tolerance which is a necessary characteristic for a successful roadside mixture in Minnesota. Among the most salt-tolerant cool-season turfgrasses are the red fescues with strong creeping red fescue (*Festuca rubra* var. *rubra*) having been rated as moderately tolerant (Torello, 1985). `North Star` Kentucky bluegrass (*Poa pratensis*) and `Brightstar` perennial ryegrass (*Lolium perenne*) were the most salt-tolerant cultivars for their individual species when evaluated against other 1995-1999 NTEP Kentucky bluegrass and perennial ryegrass cultivars (Rose-Fricker and Wipff, 2001). Germination of `Seabreeze` slender creeping fescue (*Festuca rubra* L. ssp. *mediana*) was better than other tested fine fescues at 15,000 ppm salinity levels.

An additional grass species, inland saltgrass (*Distichlis spicata*), is a warm-season grass that is hardy in northern climates (Rukavina et al., 2007; Shahba et al., 2003). The species has recently gained attention for excellent tolerance to salt stress (Hughes et al., 2002; Qian et al., 2007). Recent breeding efforts at Colorado State University have resulted in the availability of seeded cultivars that should be evaluated in Minnesota.

It should be noted that these trials were often conducted in greenhouse environments. Effective salt-tolerance studies must be conducted under roadside conditions where salt is applied and the other stresses of winter are occurring simultaneously.

PROPOSAL TITLE - Developing salt-tolerant sod mixtures for use as roadside turf in Minnesota

MNDOT ASSISTANCE:

We will need assistance in identification and preparation of 3 research sites for both objectives 1 and 2. Site identification for objective 1 will occur in summer 2010 and site identification for objective 2 will occur in summer 2011.

TASKS:

Task 1

Name: Experimental Plan for Objective 1

Description: In consultation with the TAP, we will identify 3 sites in MN for roadside cultivar evaluations (objective 1). One site will be at MnROAD, one site will be along a high-traffic roadway in the metro area, and one site will be in a residential area. We will also develop a list of cultivars for use in the roadside trial.

Duration: This task runs from month 1 to month 3.

Deliverables: An experimental plan for objective 1 (locations, trial design, cultivar list).

Cost: 3,530

Task 2

Name: Seed roadside cultivar evaluation trial

Description: We will seed the 3 roadside testing trials using standard test plot procedures.

Duration: This task runs from month 2 to month 4.

Deliverables: We will provide the TAP with a short summary discussing any issues that were encountered during the planting.

Cost: 14,121

Task 3

Name: Year 1 preliminary report

Description: Preliminary report on year 1 results.

Duration: This task runs from month 12 to month 12.

Deliverables: We will provide a preliminary report (3-5 pages) summarizing year 1 data from the roadside cultivar trial.

Cost: 26,477

Task 4

Name: Experimental Plan for Objectives 2 and 3

Description: Based on data from objective 1 (roadside cultivar trials), we will assemble mixtures for use in roadside mixture trials (obj. 2), the on-farm sod trial (obj. 2), and the water use trial (obj. 3). We will also identify sites for roadside mixture trials and determine experimental design.

Duration: This task runs from month 13 to month 14.

Deliverables: Experimental plan for Objective 2 and 3 will be delivered and approved prior to planting of trials.

Cost: 3,530

Task 5

Name: Seed roadside mixture trials, on-farm sod trial, and water use trial

Description: We will seed the trials associated with objectives 2 and 3.

Duration: This task runs from month 14 to month 16.

Deliverables: We will provide the TAP with a short summary discussing the seeding of these trials.

Cost: 14,121

Task 6

Name: Year 2 preliminary report

Description: Preliminary report on year 2 results.

Duration: This task runs from month 24 to month 24.

Deliverables: We will provide a preliminary report (3-5 pages) summarizing year 2 data from the roadside cultivar trial.

Cost: 26,477

Task 7

Name: Year 3 preliminary report

Description: Preliminary report on year 3 results.

Duration: This task runs from month 36 to month 36.

Deliverables: We will provide a preliminary report (3-5 pages) summarizing year 3 data from the roadside cultivar trial.

Cost: 44,129

Task 8

Name: Complete field data collection

Description: We will complete data collection on all field trials from objectives 2 and 3. Data will be analyzed for further reporting in final reports and other publications.

Duration: This task runs from month 40 to month 42.

Deliverables: We will provide the TAP with summarized data from all objective 2 and 3 trials.

Cost: 26,477

PROPOSAL TITLE - Developing salt-tolerant sod mixtures for use as roadside turf in Minnesota

Task 9

Name: Draft Final Report

Description: A draft final report will be prepared, following Mn/DOT publication guidelines, to document project activities, findings and recommendations.

Duration: This task runs from month 42 to month 45.

Deliverables: This report will be submitted through the publication process for technical and editorial review.

Cost: 8,826

Task 10

Name: Final Report

Description: Technical and editorial comments from the review process are incorporated into the document as appropriate. Reviewers will be consulted for clarification or discussion of comments.

Duration: This task runs from month 45 to month 48.

Deliverables: A revised final report will be prepared and submitted for publication.

Cost: 8,826

DRAFT