Low Input Turfgrass Research: Minnesota

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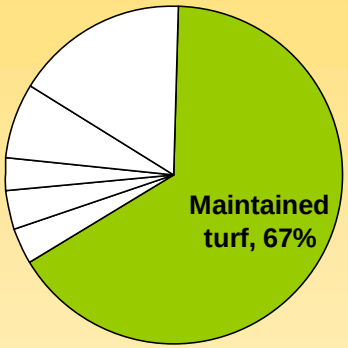
Turfgrass Research, Outreach and Education Center, St. Paul Campus

1. Rainout shelter
2. USGA putting green
3. Native soil putting green
4. Pesticide runoff
5. Fertilizer runoff
6. Breeding and genetics
7. Low-input fairways
8. Low-input grasses
9. Bee lawns
10. Consumer preference
11. Low light
12. NTEP fairway
13. NTEP putting green
14. NTEP ryegrass
15. NTEP tall fescue
16. NTEP fine fescue
17. Dollar Spot
18. Plant defense activators
19. Wetting agents

Maintained Turf Features On An Average 18 Hole Golf Course



Maintained Turf Acreage:

45 acres - 9 hole

100 acres - 18 hole

145 acres - 27 hole

(Median values)

2004 Low Input Sustainable Turf

Monthly Mowing at 2 or 4 inches or no mowing

Hard Fescue	*Festuca trachyphylla*	Prairie Junegrass	*Koeleria macrantha*
Sheep Fescue	*Festuca ovina*	Tufted Hairgrass	*Deschampsia cespitosa*
Meadow Fescue	*Festuca pratensis*	Hybrid bluegrass	*Poa arachnifera x Poa pratensis*
Colonial Bentgrass	*Agrostis capillaris*	Crested Dogs Tail	*Cynosurus cristatus*
Tall Fescue	*Festuca arundinacea*	Crested Wheatgrass	*Agropyron cristatum*
Alkaligrass	*Puccinellia distans*	Blue Grama	*Bouteloua gracilis*

5 cm hard fescue

No mow hard fescue

5 cm sheep fescue

10 cm sheep fescue

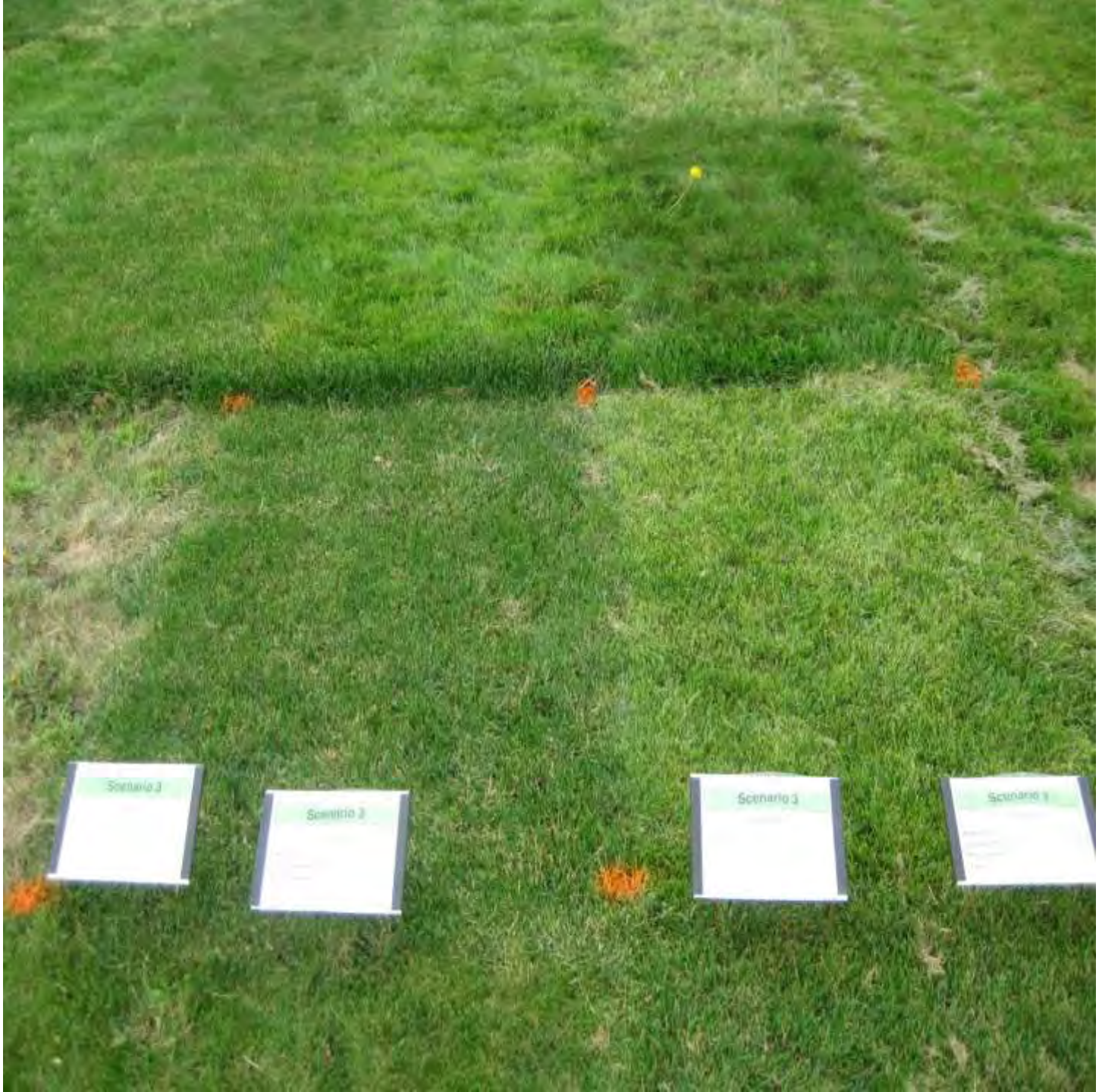
2009 Low Input Turfgrasses for Pest Management

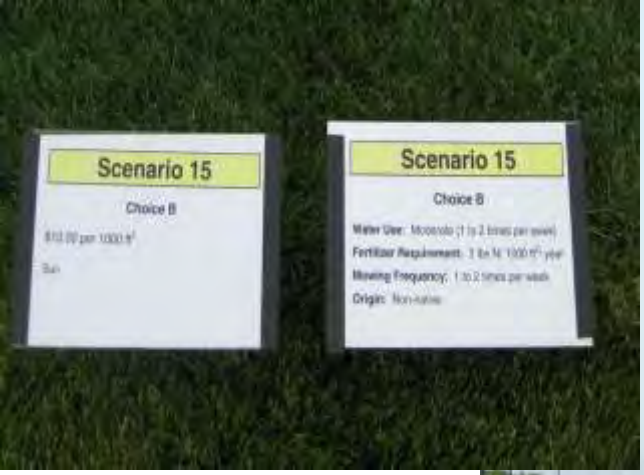
Four Alternative Grass Species Grown as Low Input

- Colonial bentgrass, Hard fescue, Tufted hairgrass, Prairie Junegrass
- 4 cultivars
- 3 fertility rates (0, 49, 98 kg N $ha^{-1}yr^{-1}$)
- 3 mowing heights (3.2, 5.7, 8.3 cm)

Homeowner Choice Scenarious- willingness to pay a premium for traits

- Water Use
- Fertilizer Requirements
- Mowing Frequency
- Origin (native or non-native)


Scenario 3
Scenario 3
Scenario 3


Scenario 15
Choice B
Scenario 15
Choice B
Origin:

Willingness to Pay

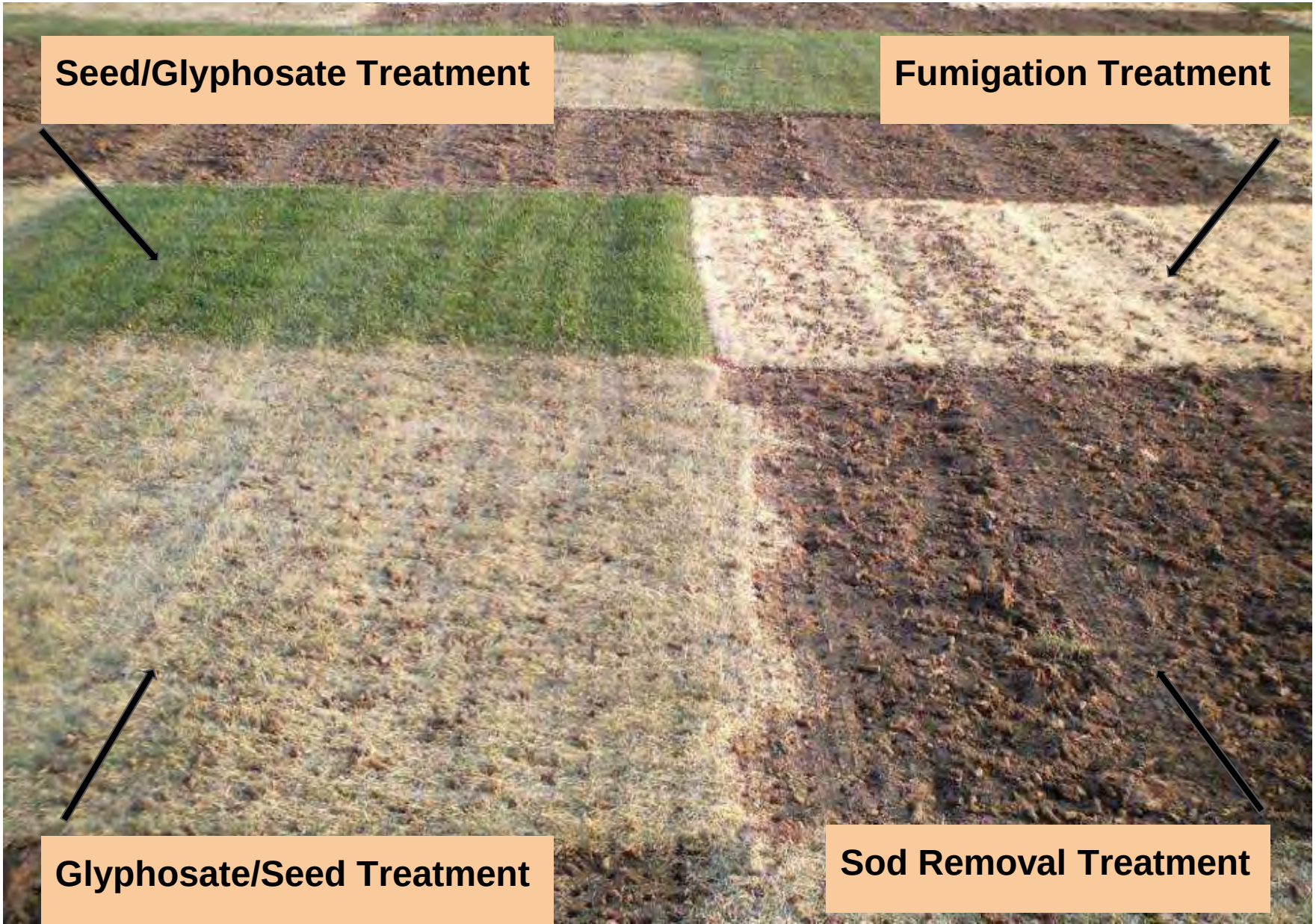
Mixed logit model, Stata 10.0

Variable	Premium
Low irrigation requirement *(less than once a week)*	$9.70
Absence of weeds	$7.49
Moderate irrigation requirement *(1-2 times per week)*	$5.85
Infrequent mowing *(once a month)*	$3.92
Color *(dark)*	$2.66

Not significant ($\alpha = .01$):

- Origin
- Fertility requirement
- Moderate mowing requirement (every other week)
- Sun vs. Sun/Shade

Conversion of Kentucky bluegrass to Fine Fescue



Conversion of Kentucky bluegrass to Fine Fescue

Species and Cultivars

- Strong Creeping red fescue “Celestial’
- Hard fescue ‘Minotaur’
- Sheep fescue common type
- Chewings fescue ‘Intrigue’
- Tufted hairgrass “SR 6000”

Conversion of Kentucky bluegrass to Fine Fescue

- Chewings and strong creeping red resisted weed invasion most
- Fumigation treatment provided a weed free stand, but too thick
- Sheep fescue produced the most biomass (playability)

Conversion of Kentucky bluegrass to Fine Fescue

- Hard fescue resisted lodging the most
- Inflorescence reduced dramatically during the second growing season
- Glyphosate/Seed treatment best overall for stand establishment and cost

July 2008

July 2009

Fine Fescue Cultivar Evaluations – Rough Height

2003 Fine Fescue NTEP
2007 Fine Fescue Cultivar Trial
2008 Fine fescue Cultivar Trial
2010 Fine Fescue Cultivar Trial
2011 Fine Fescue Cooperative Breeder's Trial
2013 Fine Fescue NTEP

Performance of fine fescue cultivars and selections in a turf trial seeded August 30, 2011 at St. Paul, MN. Includes all entries from the 2011 Cooperative Turfgrass Breeders Test.

			Turfgrass Quality[2]								
	Cultivar or Selection	Species[1]	2012-13 Avg	2012 Avg	2013 Avg	May 2013	June 2013	July 2013	Aug. 2013	Sept. 2013	Oct. 2013
1	ASR181	SLRF	6.3	6.4	6.2	5.3	5.7	6.3	6.7	6.7	6.3
2	Beacon	HDF	6.3	6.1	6.4	7.0	5.7	7.0	7.0	6.3	5.7
3	ASR172	SLRF	6.2	6.0	6.4	6.3	6.7	6.7	5.7	6.3	7.0
4	3TH3	HDF	6.2	6.0	6.3	6.3	5.7	7.0	6.7	6.3	6.0
5	50C3	CHF	6.2	6.4	5.9	7.0	6.3	6.3	6.0	5.3	4.7
6	4CHT	CHF	6.2	6.3	6.1	6.3	6.3	6.7	6.0	6.0	5.0
7	ASR176	SLRF	6.2	5.6	6.7	6.0	6.7	6.7	6.3	7.0	7.7
8	Intrigue II	CHF	6.1	6.0	6.2	6.3	6.3	7.0	6.3	5.3	6.0
9	IS-FRC36	CHF	6.1	6.1	6.0	7.3	6.7	5.7	5.3	5.3	5.7
10	IS-FL46	HDF	6.1	6.0	6.1	6.7	5.7	6.7	6.0	6.0	5.7
11	MNHD 11	HDF	6.1	6.1	6.0	6.3	5.3	6.0	6.3	6.3	5.7
12	IS-FRR68C	STRF	6.0	6.1	6.0	7.0	6.0	5.7	6.0	5.3	6.0
13	ACF277	CHF	6.0	5.7	6.3	6.7	6.3	7.0	6.3	5.7	6.0
14	PPG-FRC103	CHF	6.0	5.8	6.1	7.3	6.0	5.7	6.7	5.7	5.3
15	ACF256	CHF	5.9	6.0	5.8	6.7	6.3	5.3	6.0	5.7	5.0

2005 Low Input Fairway

Evaluation of Alternative species under lower maintenance fairway

- 20 different species
- 2 Heights of Cut (1.9 & 2.5 cm)
- 3 levels of Golf cart traffic simulation,
  - 0,1, or 2 passes 3x a week
- Irrigation to prevent dormancy

Fine Fescue at Fairway Height

2008 Fine Fescue NTEP

2012 Fine Fescue SCRI

2013 Fine Fescue NTEP

2008 NTEP Fine Fescue Fairway

Performance of fine fescue cultivars and selections in a fairway turf trial seeded September 8, 2008 at St. Paul, MN. (Includes 2008 National Fine Fescue Test – NTEP)

			Turf Quality[2]			% Cover[3]					Spring	Genetic
			Traffic	No Traffic			Traffic		No Traffic		Green-Up[4]	Color[5]
	Cultivar or Selection	Species[1]	2010 Avg.	2010 Avg.	2009-2010 Avg.	Spring	Summer	Fall	Summer	Fall	April 2010	July 2010
1	Fairmont	CHF	7.0	7.8	7.6	96.7	95.0	96.7	98.3	100.0	6.7	5.3
2	PSG50C3	CHF	6.4	7.8	7.2	96.7	93.3	93.3	96.7	96.7	5.7	5.0
3	MVS-FRC-101	CHF	6.2	7.6	7.3	95.0	93.3	93.3	98.3	100.0	6.0	5.3
4	IS-FRR-33	CHF	6.1	7.0	6.8	91.7	91.7	95.0	100.0	96.7	6.0	4.7
5	IS-FRR-35	CHF	6.1	6.9	6.6	90.0	91.7	96.7	96.7	100.0	7.0	4.3
6	Zodiac	CHF	6.1	6.7	6.3	96.7	93.3	95.0	96.7	100.0	7.0	6.0
7	Treazure II	CHF	6.0	6.9	6.8	96.7	91.7	93.3	98.3	96.7	5.7	4.0
8	MNHD1	HDF	5.9	6.4	6.5	95.0	91.7	95.0	98.3	96.7	6.7	5.0
9	Intrigue 2	CHF	5.8	6.8	6.7	95.0	91.7	93.3	98.3	96.7	6.7	4.7
10	IS-FRR-62	STRF	5.7	6.8	6.9	95.0	90.0	90.0	91.7	95.0	4.3	4.3

2011 Fine Fescue Mixtures for Fairways

USGA Funded Fine Fescue Fairway Research

3 projects to evaluate species mixtures and management practices:

Traffic tolerance and divot recovery measurements (2013-2015)

Snow scald (*Myriosclerotinia borealis*) inoculation (2014-2015)

Drought trial (2015)

Data collected will determine best species proportions and effective management to successfully use fine fescues for golf course fairways

Plant material

Fine fescue species		Cultivar
Chewings fescue	*Festuca rubra* ssp. *fallax*	‘Treazure II’
Hard fescue	*Festuca trachyphylla*	‘Beacon’
Sheep fescue	*Festuca ovina*	‘Quatro’
Slender creeping red fescue	*Festuca rubra* ssp. *litoralis*	‘Shoreline’

Mix	Species 1	Species 2	Species 3	Species 4	Species 5
1	0	0	0	0	1
2	0	0	0	1/2	1/2
3	0	0	1/3	1/3	1/3
4	0	1/4	1/4	1/4	1/4
5	1/5	1/5	1/5	1/5	1/5
…25					

Traffic tolerance and divot recovery

Site establishment & maintenance

Plots were established in summer 2012

Supplemental irrigation was provided only during establishment period

Trial was fertilized with 98.0 kg N ha^{-1} (18-0-18) per year, split into spring and fall

Plots were mowed (clippings collected) at 1.23 cm

Traffic tolerance and divot recovery

Treatments

PGR treatment

- Trinexapac-ethyl (Primo MAXX)
- 0 g ai ha^{-1} or 48 g ai ha^{-1}
- Every 200 growing degree days (Kreuser and Soldat, 2011)
- 1 June to 15 October of 2013-2014

Traffic treatment

- 0 or 6 passes per week
- Golf cart traffic simulator
- 1 July to 31 August of 2013-2014

Mixture treatment

- 25 different mixtures of 5 fine fescue species

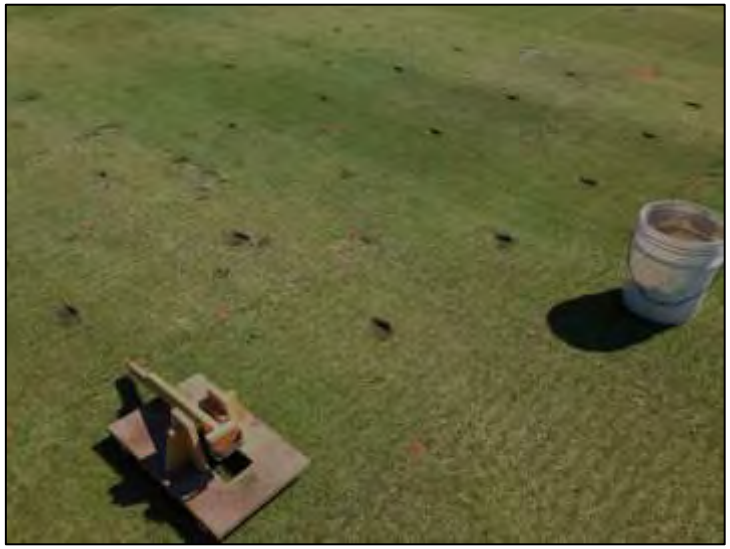
Traffic tolerance and divot recovery

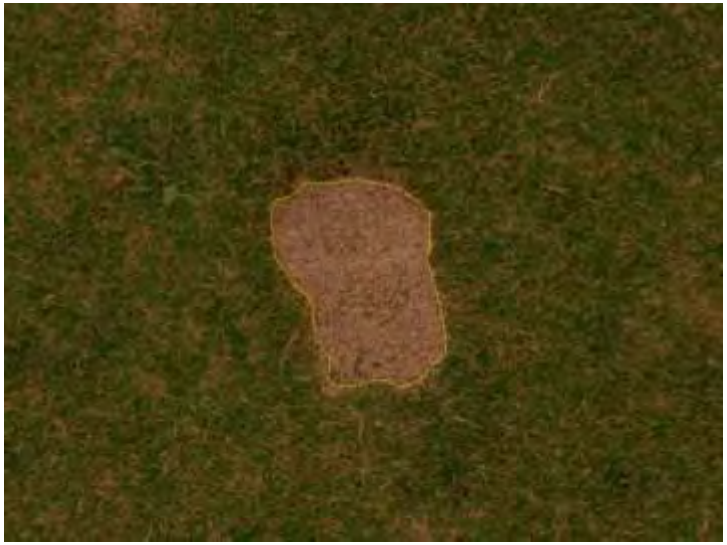
Data collection

- Turf quality ratings (1-9 scale)
- Digital images
- Weed invasion
- Surface firmness
- Divot recovery

    1 divot per sub-sub-plot

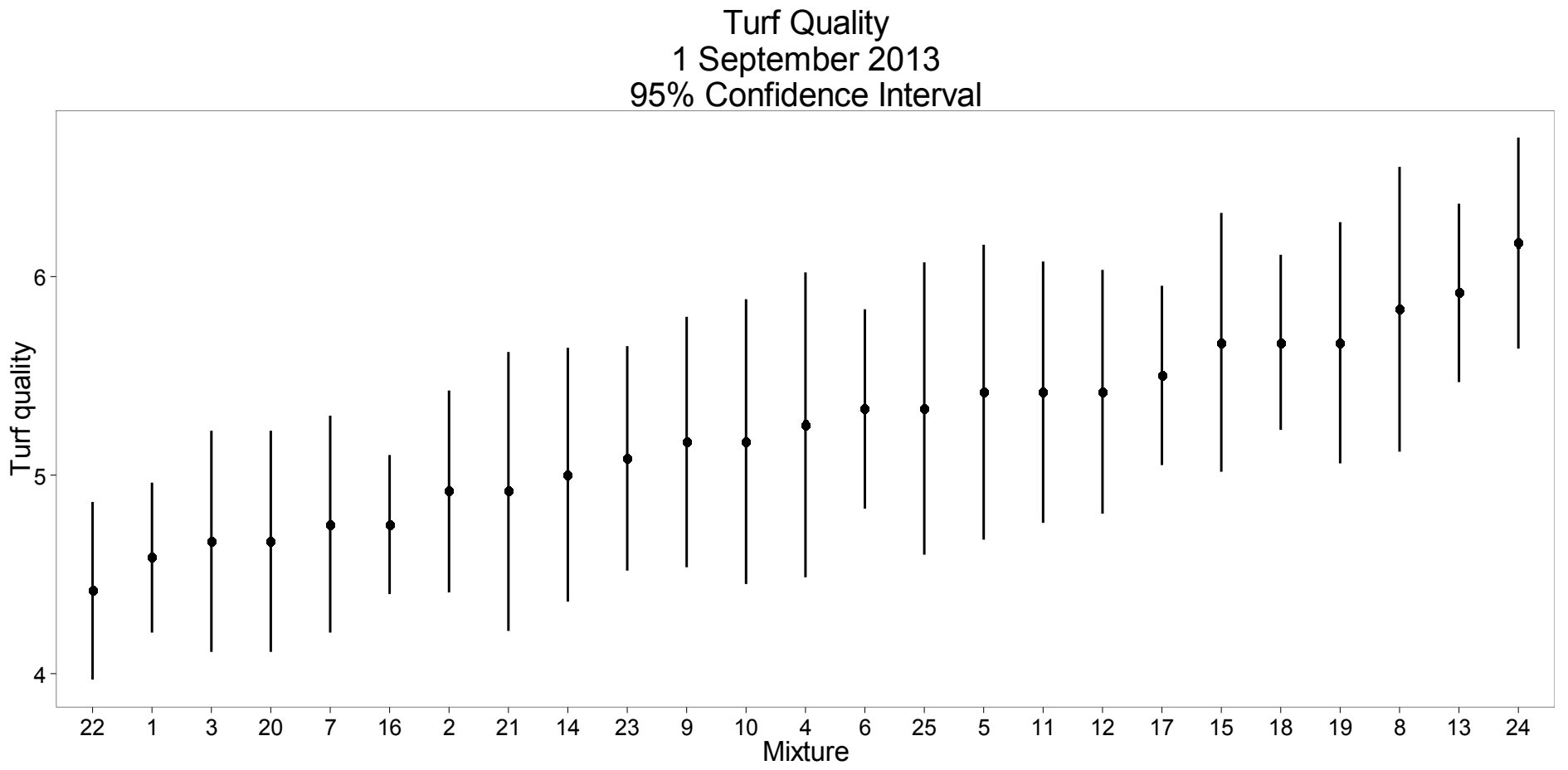
    Recovery of area

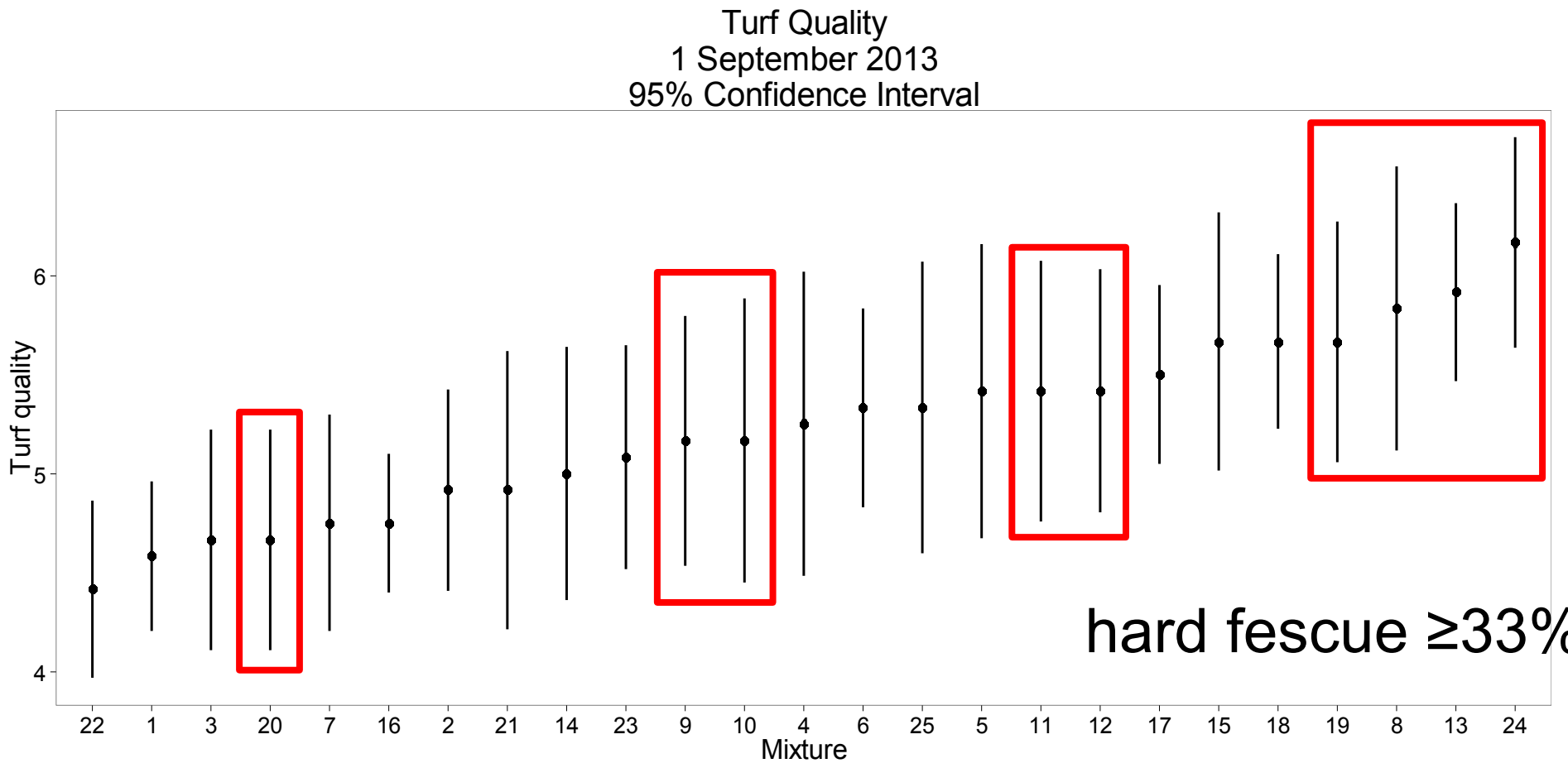


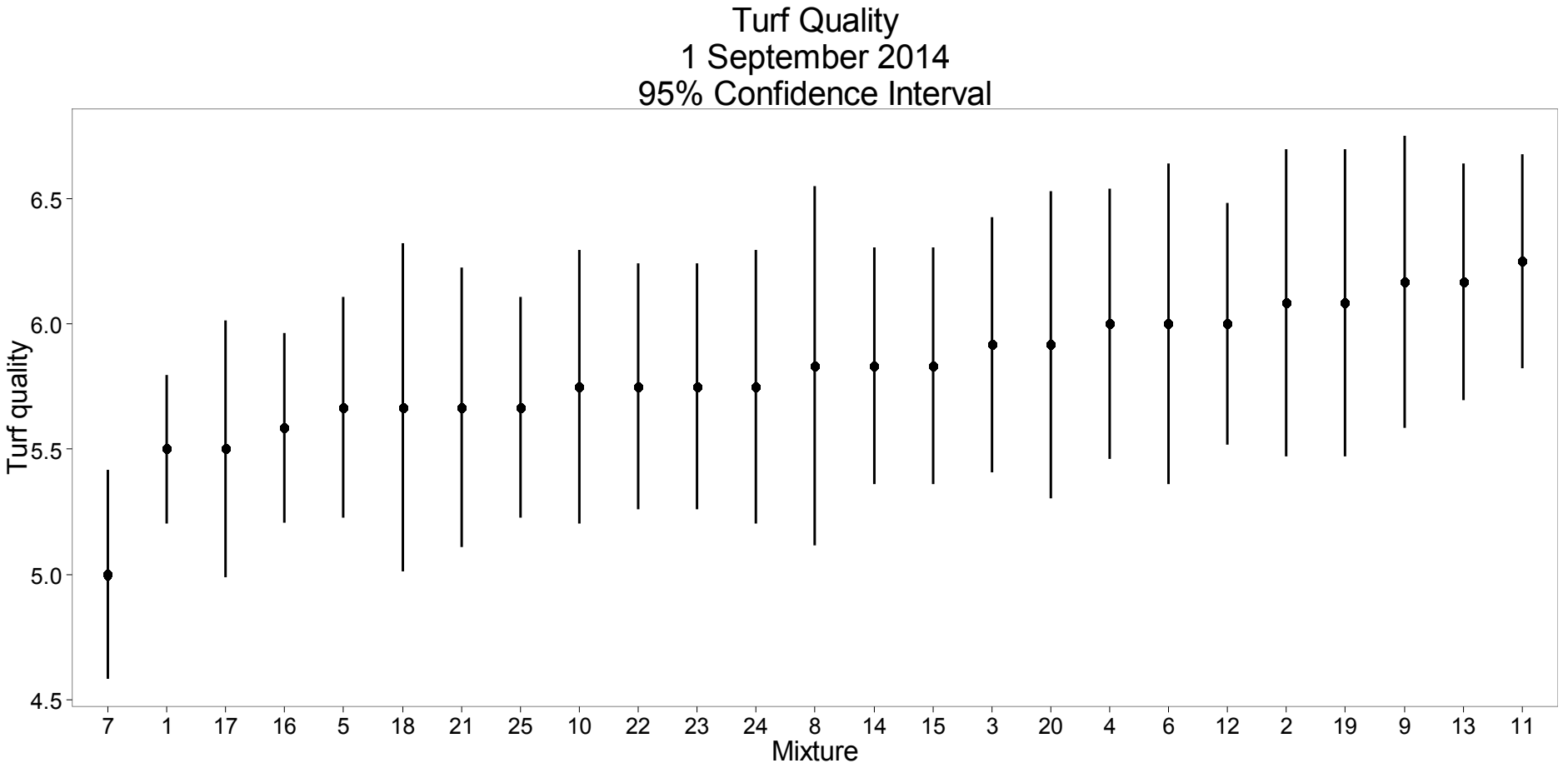


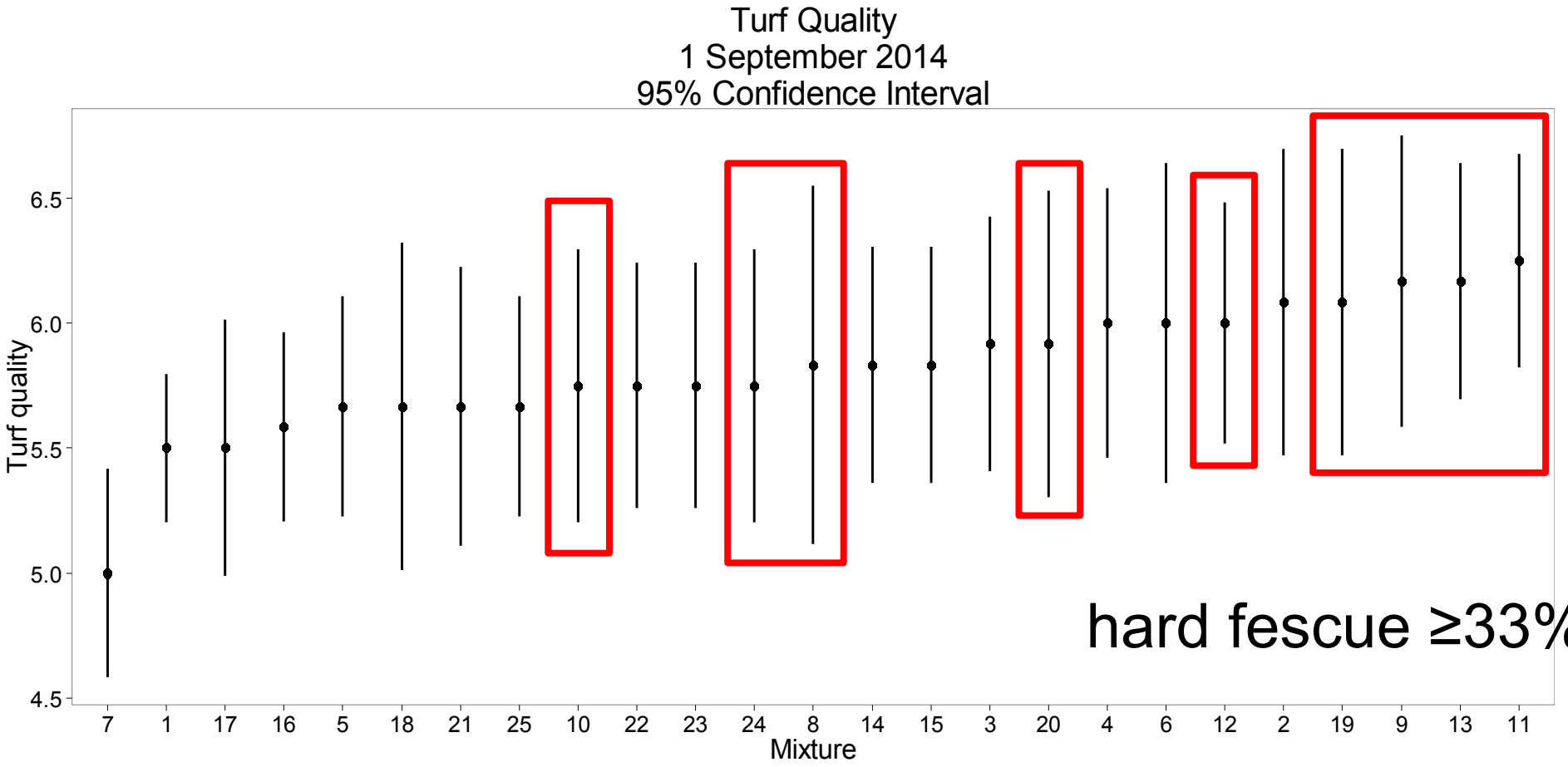
Traffic tolerance and divot recovery

Treatment	Turf quality		Divot recovery
	Sept 2013	Sept 2014	
PGR	ns	ns	ns
Traffic	*	*	ns
Mixture	*	*	*


Turf Quality
1 September 2013
95% Confidence Interval
Turf quality
6
5
4
22 1 3 20 7 16 2 21 14 23 9 10 4 6 25 5 11 12 17 15 18 19 8 13 24
Mixture


Turf Quality
1 September 2013
95% Confidence Interval
Turf quality
6
5
4
22 1 3 20 7 16 2 21 14 23 9 10 4 6 25 5 11 12 17 15 18 19 8 13 24
Mixture
hard fescue ≥33%


Turf Quality
1 September 2014
95% Confidence Interval
Turf quality
6.5
6.0
5.5
5.0
4.5
7
1
17
16
5
18
21
25
10
22
23
24
8
14
15
3
20
4
6
12
2
19
9
13
11
Mixture


Turf Quality
1 September 2014
95% Confidence Interval
Turf quality
6.5
6.0
5.5
5.0
4.5
7
1
17
16
5
18
21
25
10
22
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20
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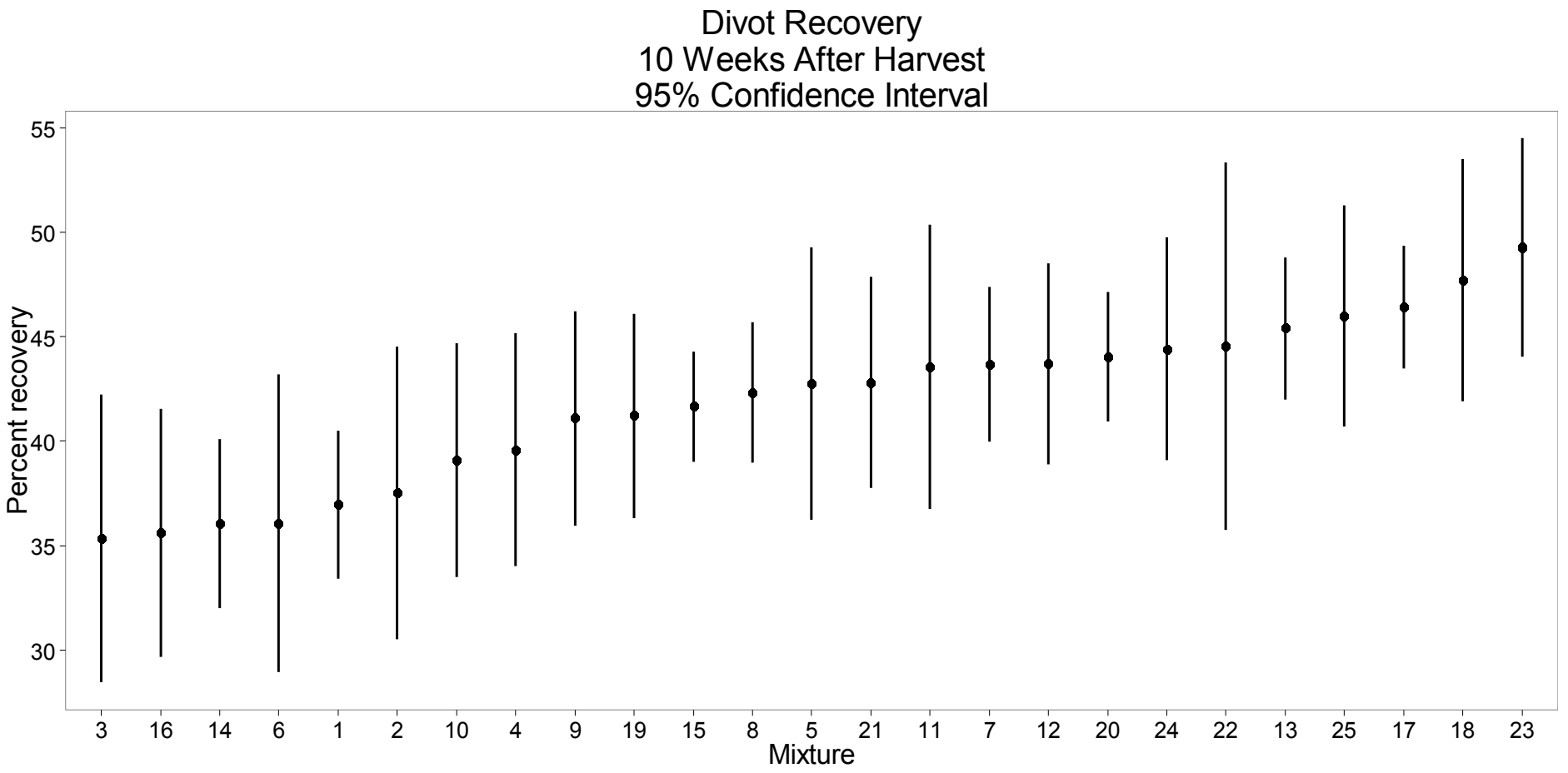
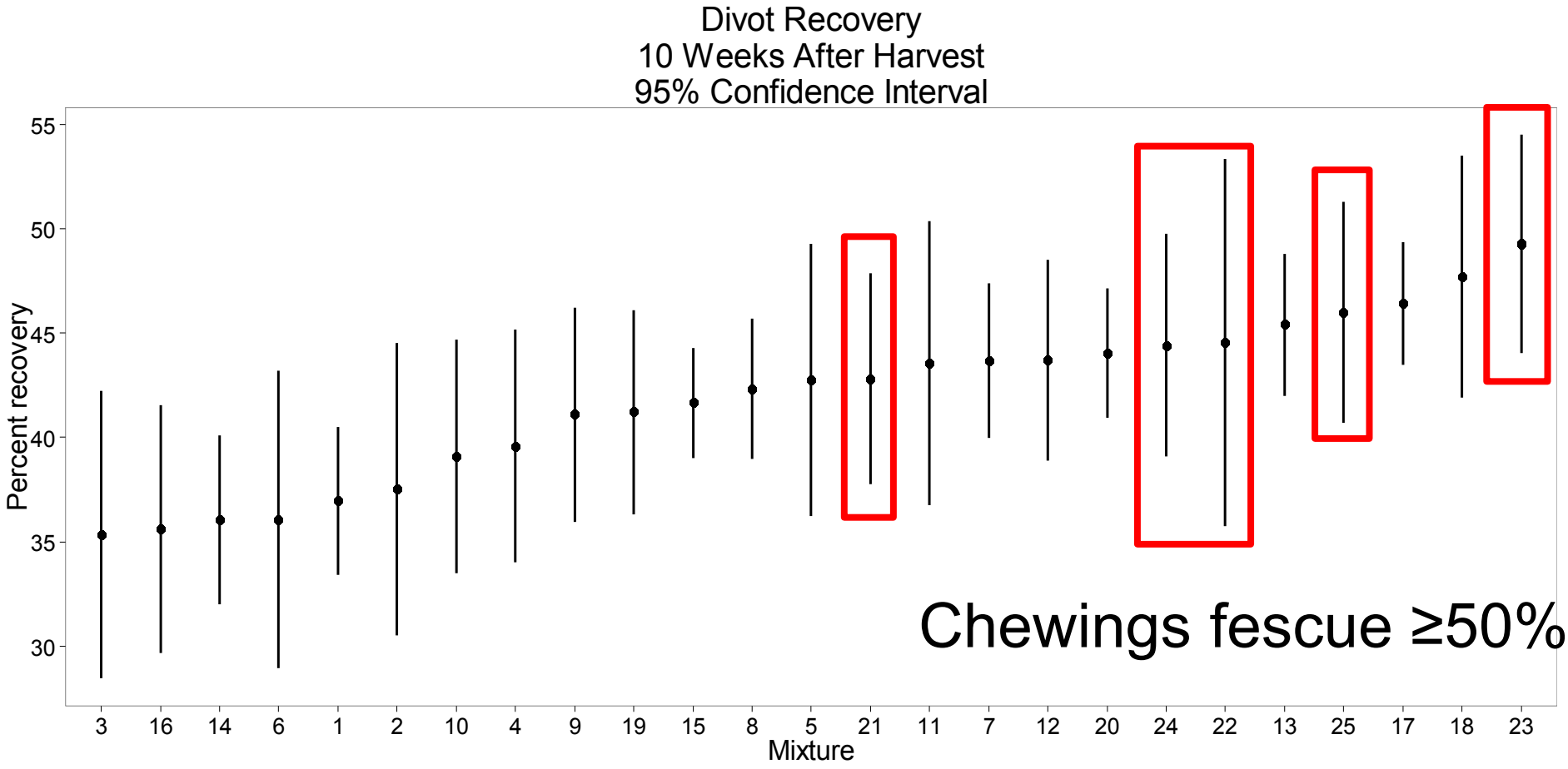
2
19
9
13
11
Mixture
hard fescue ≥33%


Divot Recovery
10 Weeks After Harvest
95% Confidence Interval
Percent recovery
55
50
45
40
35
30
3 16 14 6 1 2 10 4 9 19 15 8 5 21 11 7 12 20 24 22 13 25 17 18 23
Mixture


Divot Recovery
10 Weeks After Harvest
95% Confidence Interval
Percent recovery
55
50
45
40
35
30
3 16 14 6 1 2 10 4 9 19 15 8 5 21 11 7 12 20 24 22 13 25 17 18 23
Mixture
Chewings fescue ≥50%

Divot recovery

Fairy ring April 2015

Fairy ring April 2015

Fall 2014: snow scald inoculum spread over plots and trial area covered to foster disease development

April 2015: collect disease data, no disease

Summary & Conclusions

PGR (Trinexapac-ethyl) has no effect on traffic tolerance or divot recovery in fine fescue fairway mixtures

Mixtures play some role in the performance of fine fescue fairways, but speed of divot recovery is slow

Field sites did not develop any snow mold or snow scald, even when inoculated

2009 Fine Fescue Putting Green

Comparison of Fine Fescue Species to Bentgrass Species

- 3 Bentgrass (creeping, colonial, velvet)
- 3 Fine fescues (hard, sheep, Chewings)

Three Mowing heights

- 3, 6, and 9 mm

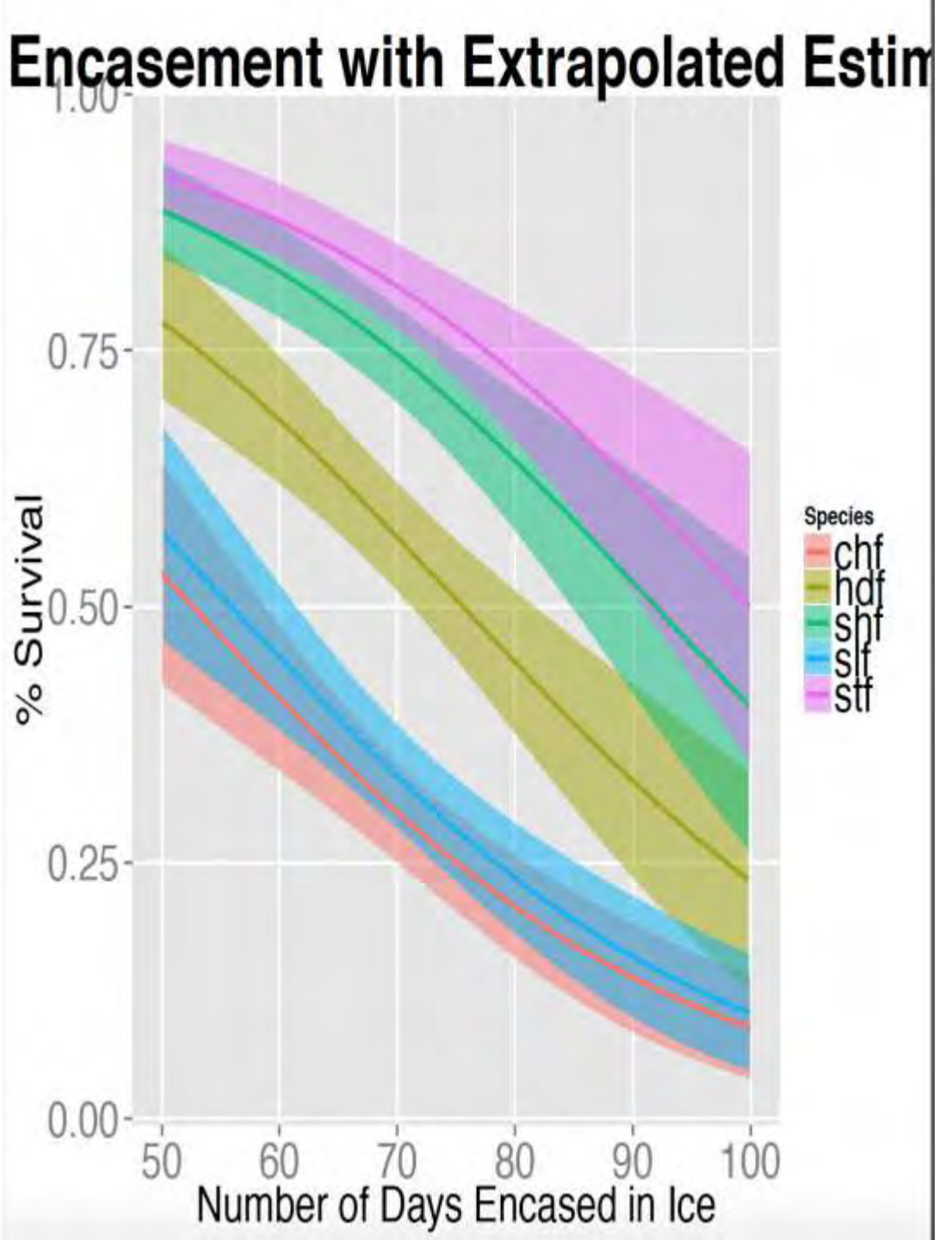
Reduced Fertility

- 2.45 kg N $ha^{-1}wk^{-1}$

Irrigation at 60% ET

Fine fescue putting green

Fine Fescue Ice Encapsulation Study


Encasement with Extrapolated Estim
1.00
0.75
0.50
0.25
0.00
% Survival
50
60
70
80
90
100
Number of Days Encased in Ice
Species
chf
hdf
shf
slf
stf

2014 Fine Fescue Putting Green

Evaluation of species and cultivars

- 5 cm sand cap
- 5 mm HOC
- Mowed 5 days a week
- Topdressed biweekly
- 1 fungicide application this year
- Very little supplemental irrigation

Bentgrass vs. fine fescue fertility

- High vs. low fertility
- Will be conducted in 2016

Fine Fescue Glyphosate Tolerance

Rough Height

4 way mixture

Survived at 11, 22, 32 fl oz/A

(0.8, 1.5, 2.3 L/ha)

Killed at 48, 64, 88, 116 fl oz/A

(3.3, 4.5, 6.2, 8.1 L/ha)

Fine Fescue Glyphosate Tolerance

Fairway Height (0.5 inch)

2008 FF NTEP

11 fl oz/A (0.8L/ha)

22 fl oz/A (1.5L/ha)

33 fl oz/A (2.3L/ha)

		RoundUp WeatherMax		
Cultivar or Selection	Species	11 fl oz/A	22 fl oz/A	33 fl oz/A
1 Bighorn GT	Blue Hard Fescue	8.0	6.7	5.3
2 Spartan II	Hard Fescue	8.0	5.3	4.3
3 Beacon	Hard Fescue	8.0	5.3	4.0
4 Sword	Hard Fescue	7.7	5.3	4.0
5 PST-4HES	Hard Fescue	6.3	4.7	3.3
6 Gotham	Hard Fescue	7.7	4.3	3.7
7 MNHD1	Hard Fescue	7.0	4.0	3.3
8 Aberdeen	Strong Creeping Red Fescue	6.7	3.7	3.0
9 Epic	Strong Creeping Red Fescue	7.0	3.0	1.7
10 Shademaster III	Strong Creeping Red Fescue	6.0	3.0	2.0
11 PST-5RM	Strong Creeping Red Fescue	6.0	3.0	2.0
12 Rosecity	Chewing's Fescue	5.7	3.0	2.0
13 Chantilly	Strong Creeping Red Fescue	5.7	3.0	2.0
14 Navigator II	Strong Creeping Red Fescue	5.7	2.7	1.7
15 PST-4CSD	Chewing's Fescue	5.3	2.7	1.7
16 Boreal	Strong Creeping Red Fescue	5.0	2.7	2.0
17 Intrigue 2	Chewing's Fescue	4.7	2.7	1.7
18 Zodiac	Chewing's Fescue	4.7	2.7	1.7
19 Wrigley 2	Chewing's Fescue	4.7	2.7	1.7
20 Treazure II	Chewing's Fescue	4.3	2.7	1.3
21 PSG 50C3	Chewing's Fescue	4.3	2.7	1.3
22 Lacrosse	Chewing's Fescue	4.3	2.7	1.7
23 Cascade	Chewing's Fescue	4.7	2.3	1.7
24 Longfellow 3	Chewing's Fescue	4.3	2.3	1.3
25 Radar	Chewing's Fescue	4.0	2.0	1.3
26 Fairmont	Chewing's Fescue	3.0	2.0	1.0
LSD (P=.05)		1.6	1.3	1.2

Fine Fescue Tolerance to Sethoxydim

Objective: To compare the tolerance of cool-season turfgrass species and cultivars to sethoxydim and determined their tolerance at different application rates.

Species

- Kentucky bluegrass, tufted hairgrass, perennial tyegrass, tall fescue, prairie junegrass, Chewings fescue, hard fescue, strong creeping red fescue, sheep fescue

Rates

- 0.0, 1.32, 2.63 and 5.26 $L \cdot ha^{-1}$ (0.5x, 1x and 2x of labeled rate)

Conclusions

- All fine fescue species were unaffected by all rates of sethoxydim
- Only other species to show tolerance were tufted hairgrass & tall fescue, but damage was still seen.
- Sethoxydim can be safely used for grassy weed control in the fine fescue species

Grass Control in Fine Fescue Fairways

Fluazifop
6 fl oz/A (0.4L/ha)
Sethoxydim
36 fl oz/A (2.5L/ha)
Mesotrione
5 fl oz/A (0.35L/ha)
Glyphosate
8, 16, 32 fl oz/A
(0.56, 1.1, 2.2 L/ha)

Fine Fescue Seeding Rate

Seed Rate Based on Pure Live Seed (PLS)

5 species of fine fescue

strong, slender, Chewings, hard, sheep

6 rates of seed

0.125, 0.25 0.5,1, 2, 3 PLS/cm2

Reported Seed Weights

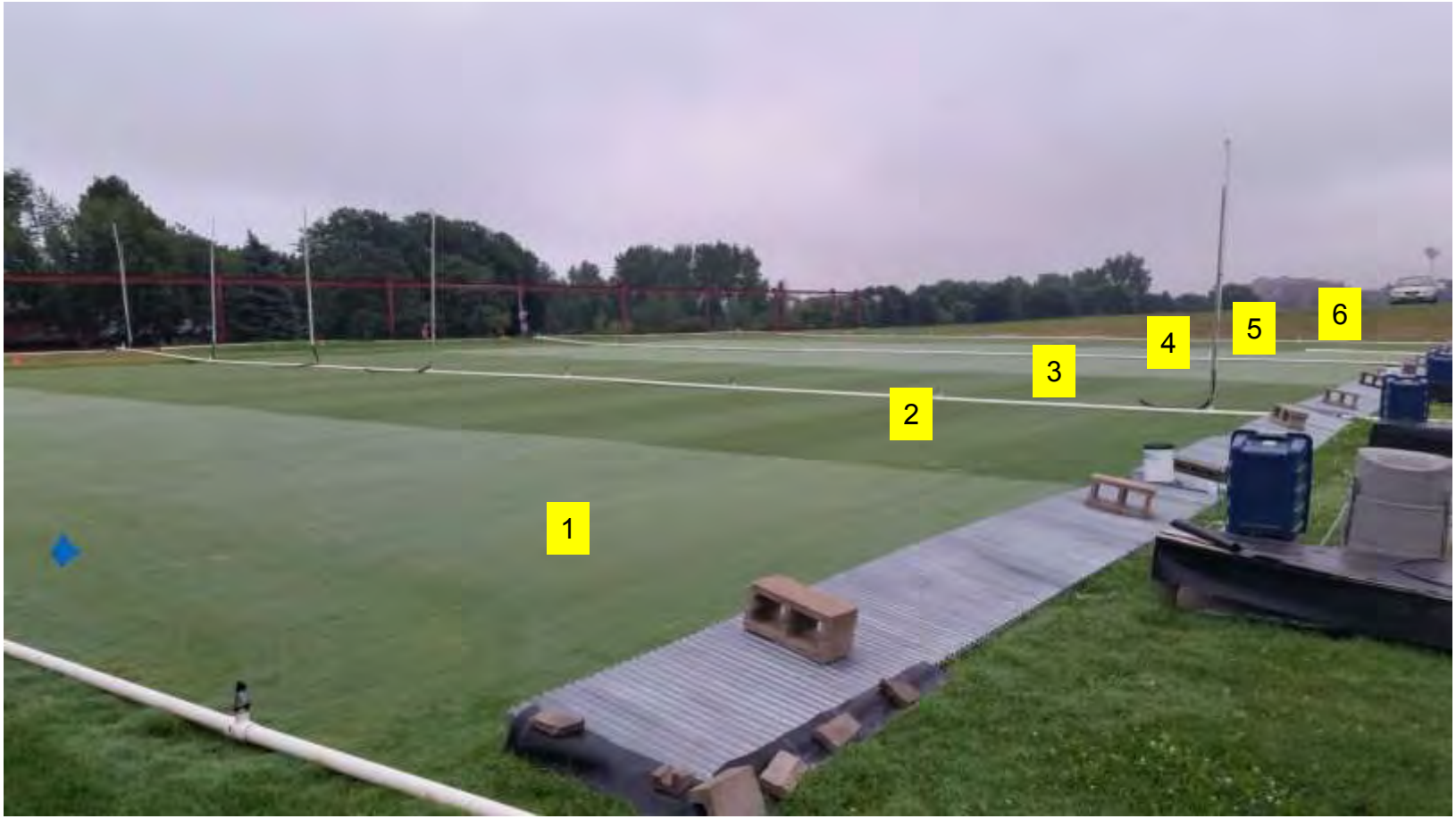
cultivar	species	Seeds/pound
Windward	Chewings	475,000
Garnet	Strong creeping	511,000
Jasper II	Strong creeping	430,000
Spartan II	Hard	510,000
Azay	Sheep	550,000
Sealink	Slender creeping	460,000
Blue Heron	Blue	500,000
Daisy	Sheep	680,000
Fairmont	Chewings	365,000
Little Bighorn	American Sheep	500,000
Bighorn GT	Hard	500,000
Boreal	Strong creeping	320,000
Navigator II	Strong creeping	350,000

- From Pickseed and Landmark Seed Websites

Turf Runoff Study: Creeping Bentgrass verses Fine Fescue Mix

P.I.'s
Pamela Rice, USDA-ARS
Brian Horgan, University of Minnesota

St. Paul, MN



Creeping Bentgrass verses Fine Fescue Mix

- Morning frost shows clear distinction between the two types of turf
- Creeping Bengrass (plots 1, 4 and 5)
- Fine Fescue Mix (plots 2, 3 and 6)
- Runoff is collected from a 20 ft wide by 80 ft long area for each plot, 4% slope
- Managed as a standard golf course fairway (1.25 cm height of cut)
- Turf seeded August 2011

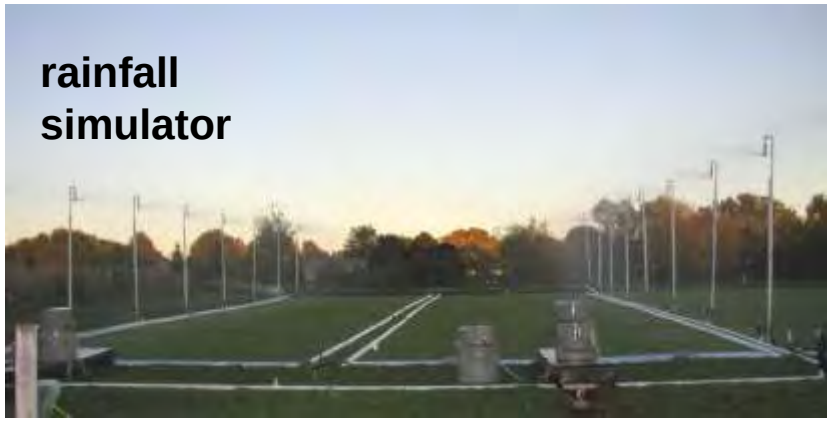
Pesticide application

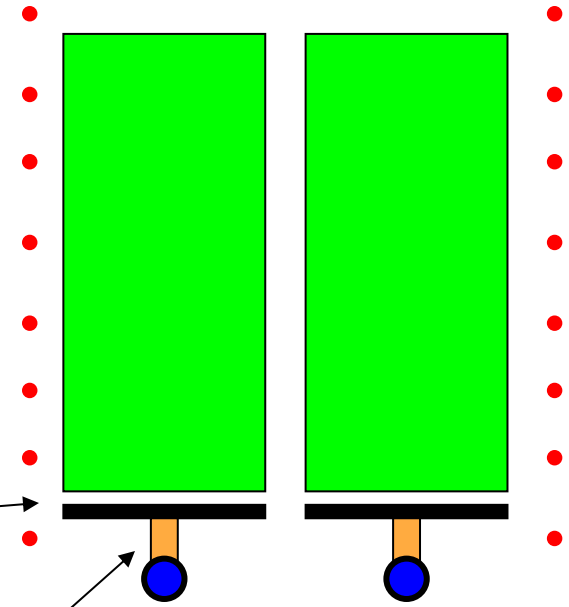
- Runoff gutters are covered with plastic to prevent contamination with spray drift
- Tank mix of commercially available products
- Glass Petri dishes capture actual application rates

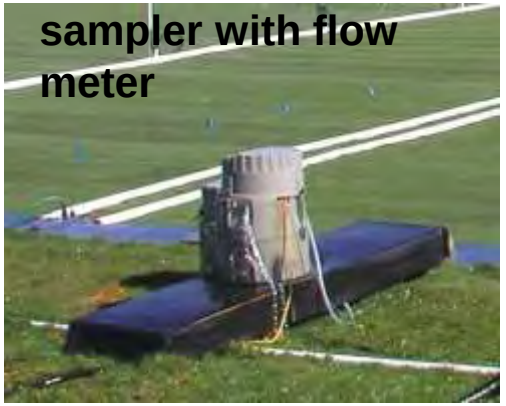
Rainfall simulation

•Rainfall simulator based on design of Coody and Lawrence 1994, US Patent 5,279,151
•Simulation performed on 2 plots simultaneously, a BG and FF replicate with each plot pair
•Rain gauges distributed on a grid pattern measure actual precipitation received
•Flow meters (ISCO 4230) and samplers (ISCO 6700) record data and collect samples in glass bottles
•PVC berms isolate plots – no observed flow between plots, 4% slope directs runoff to gutters
•Plastic sheeting on perimeter of adjacent plots prevent experimental artifacts from precipitation drift

Turf Plots: Runoff Collection

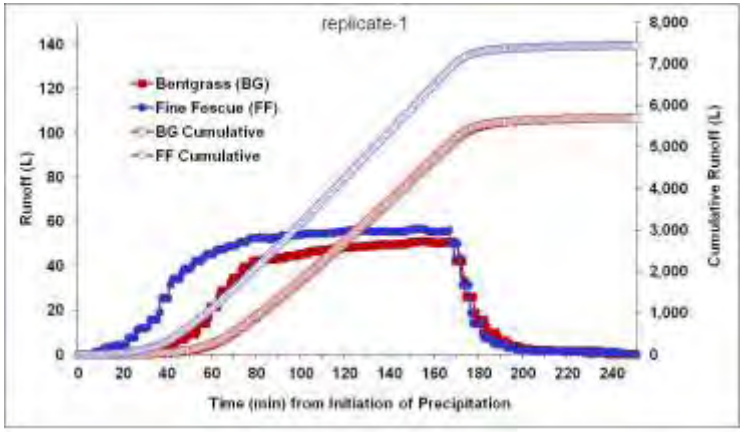


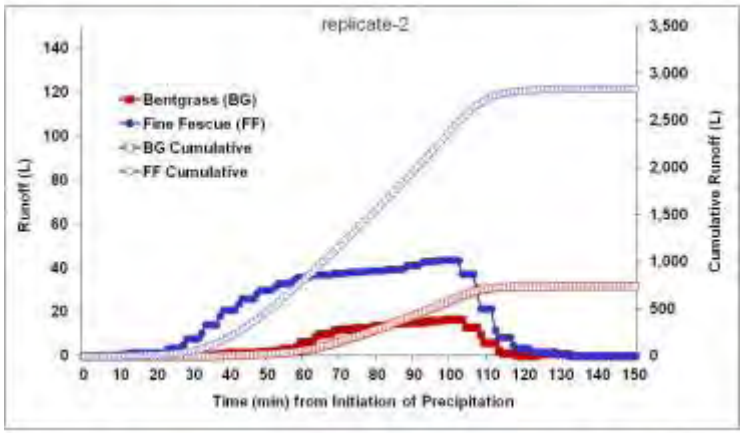


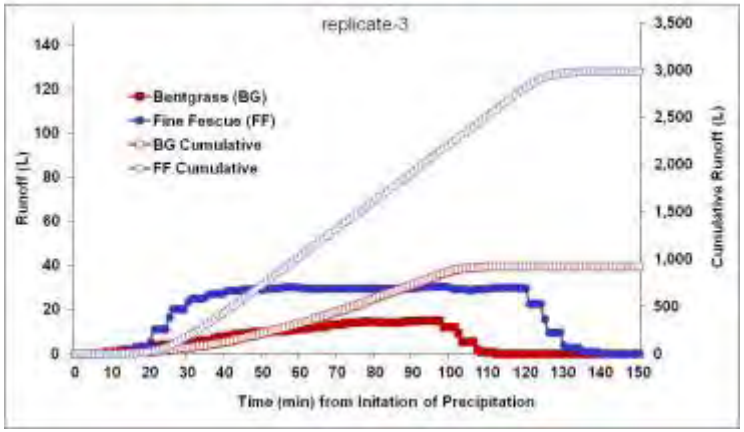


ISCO Samplers, Flow Meters and Rain Gauges

Evaluation of Snow Melt Runoff for Fall-Applied fungicides







Creeping Bentgrass vs. Fine Fescue Mix Simulated Precipitation

Precipitation intensity
- 38 ± 3 mm/hr (1.5 ± 0.1 inches/hr)

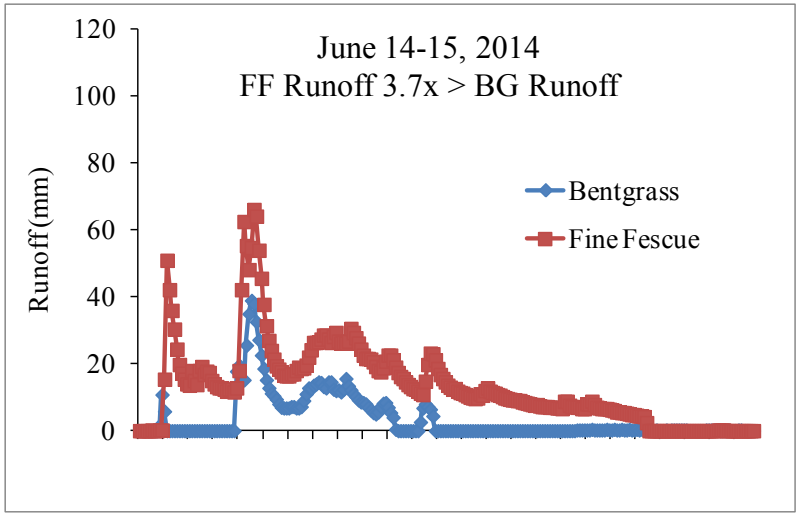
Precipitation duration
- 169 minutes (replicate-1)
- 112 ± 10 minutes (replicates 2&3)

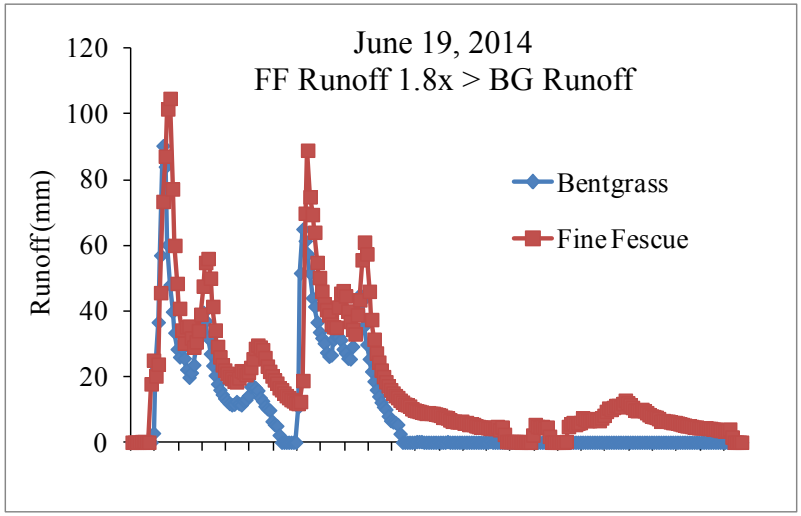
Runoff volume (L)
- BG = 5,694 L; FF = 7,818 L (replicate-1)
- BG = 832 ± 125 L; FF = 2,846 ± 197 L (repl. 2&3)

% of precipitation as runoff
- BG = 35%; FF = 55% (replicate-1)
- BG = 7.6 ± 0.2 %; FF = 27 ± 1.5 % (repl. 2&3)

Greater runoff volume from FF than BG
FF 1.4x > BG (replicate-1)
FF 3.4 ± 0.3x > BG (replicates 2 & 3)

Creeping Bentgrass vs. Fine Fescue Mix
Natural Precipitation





<u>Greater runoff volume from FF than BG</u>

- FF 3.7x > BG (June 15-15, 2014)
- FF 1.8x > BG (June 19, 2014)
- Similar to the simulated precipitation data

Preliminary data: Field season #1

Thank You!

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UNIVERSITY OF MINNESOTA

Driven to Discover℠

2010 Fine Fescue Roadside/Salt Tolerance

Evaluate Turfgrass Suitable for roadsides

75 different cultivars (23 fine fescues)

4 different location

MNRoad Research Center
35W
Roselawn Cemetary
Gortner Avenue

Hydroponic Evaluation

Screened 75 different cultivars (23 f. fescues)
8 dS/m, 16 dS/M, 24 ds/M

Table 3. Roselawn boulevard salt tolerance performance by species ranked in order of performance (1 = best).

1. sheep fescue
2. slender creeping red fescue
3. Chewings fescue
4. blue hard fescue
5. alkaligrass
6. strong creeping red fescue
7. hard fescue
8. tufted hairgrass
9. tall fescue
10. creeping bentgrass
11. perennial ryegrass
12. Kentucky bluegrass
13. Idaho bentgrass
14. prairie junegrass


come from
Sysco

MNDot Sod Mixtures

Develop a Better Salt Tolerant (fine fescue) Sod Mixture

50 different Mixtures

Strength Tested

- shear strength (Shear vane tester)
- Sod Tensile strength

Evaluated for Drought Stress