Evaluation of Ryegrasses, Fescues, and Their Hybrids Under Deficit Irrigation

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Cool-season turfgrasses dominate the landscape and golf courses throughout California and much of the U.S. because of their ability to retain green color year round, with supplemental irrigation, in drier climates. However, increasing drought frequency and diminishing water resources are jeopardizing the future of turf and its benefits to the game, urban culture, the environment, and the economy. Perennial ryegrass (*Lolium perenne* L.) is widely used because of its rapid germination and establishment; wear tolerance; and dark green color. By intercrossing with meadow fescue (*Festuca pratensis* Huds.) and recurrent selection for drought and heat tolerance, we have developed a population of perennial ryegrass with a marked increase in drought tolerance. This increase was associated with a dramatic increase in the frequency of introgression of *F. pratensis* chromatin on the short arm of chromosome 3. In studies in the United Kingdom on forage-type interspecific hybrids of fescues and ryegrasses, this specific segment of F. pratensis chromatin was associated with deep rooting, drought, heat, freezing, and flood tolerance. We believe that extreme selection applied to our materials favored the specific genome regions from *F. pratensis* responsible for drought and heat tolerance under Southern California conditions.

We now have populations of turf-type perennial ryegrass with high frequencies of *F. pratensis* introgressions that are related to stress resistance. The objective of this study was to test these populations in the field against commercially available tall fescue and perennial ryegrass cultivars under deficit irrigation (60% ETo).

Location:	UCR Turf Facility
Soil:	Hanford fine sandy loam
Experimental Design:	Randomized complete block with 3 replications
Plot Size:	5 ft by 5 ft
Seed Established:	24 November 2010
Fertility:	0.5 lb N/1000 ft^2 approximately monthly
Mowing Height:	2 inches
Irrigation Regimes:	Maintained at (150% ET_O)/ DU until start of study, then 60% ET_o replacement divided into three times weekly irrigated by hand
Deficit irrigation Initiated:	29 June 2011

Data Collection: Turf quality (1-9, 9 = best; 6 = minimally acceptable turf), color quality (1-9, 9 = best, 6 minimally acceptable turf), percent cover brown tissue, clippings, soil water content per plot using TDR, and NDVI per plot; Electrolyte leakage

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Treatments:

1. 'Tulsa Time' Tall Fescue
2. 'Laura' Meadow Fescue
3. 'SR4220' Perennial Ryegrass
4. 3s" 16 Festulolium
5. VL 3s' Festulolium
6. 3s" 11 Festulolium
7. 'Zoom' Perennial Ryegrass

Plot Map:

North

1	2	3	4	5	6	7
5	3	7	4	1	6	2
3	2	7	6	5	1	4

South

Preliminary Results:

- ✓ As drought stress from deficit irrigation progressed, ‘Zoom’ perennial ryegrass has exhibited significantly greater turf quality and less straw tissue, followed next by the Festulolium populations and ‘SR 4220’ (backcross parent), and then the fescues (Tables 1 and 2).
- ✓ While deficit irrigation did reduce clipping yield over time, there were no significant changes among the species and cultivars as a possible effect of drought tolerance (Table 3).
- ✓ Thus far, our field and greenhouse studies continue to demonsrate increased turf quality of Festulolium compared to tall fescue in response to severe drought or deficit irrigation. However, our populations do not show a marked difference in comparison with ‘SR 4220’, the recurrent backcross parent in the Festulolium lines, and less superiority in comparison with ‘Zoom’ a commercial ryegrass cultivar selected for improved drought tolerance.
- ✓ Our studies will continue to determine the physiological and cytogenetic bases for these observations in the field, with the ultimate goal of developing a cool-season turfgrass that requires less water during the summer months.

Table 1. Quality (1-9, 9 = best) of turfgrasses in response to deficit irrigation imposed on 29 June 2011. Riverside, CA.

Treatment	0 DAT	14 DAT	28 DAT	42 DAT	57 DAT	70 DAT
'Tulsa Time' Tall Fescue	7	7	5.3 a	2.3 c	3 c	3 c
'Laura' Meadow Fescue	6	6	4 b	3.0 bc	3 c	3 c
'SR4220' Perennial Rye	7	6.3	5.3 a	4.0 ab	4 ab	4 b
3s" 16 Festulolium	7	6.7	5.7 a	3.3 abc	3.7 bc	3.7 b
VL 3s' Festulolium	7	6.3	5.7 a	3.3 abc	3.7 bc	4 b
3s" 11 Festulolium	7	6.7	6 a	3.3 abc	3.3 bc	4 b
'Zoom' Perennial Rye	7	7	6.3 a	4.3 a	4.7 a	4.7 a
LSD (α = 0.05)	**NS**	**NS**	**0.9**	**1.1**	**0.7**	**0.6**

Means followed by the same letter do not significantly differ (P=0.05). NS = Not significant.

Table 2. Percent straw color leaves in response to deficit irrigation imposed on 29 June 2011. Riverside, CA.

Treatment	0 DAT	14 DAT	28 DAT	42 DAT	57 DAT	70 DAT
'Tulsa Time' Tall Fescue	2.3 c	5.7	28.3	70.0 a	73.3 a	70.0 a
'Laura' Meadow Fescue	3.7 bc	9.0	31.7	63.3 a	70.0 a	66.7 ab
'SR4220' Perennial Rye	5.7 a	11.7	28.3	38.3 bc	31.7 b	43.3 cd
3s" 16 Festulolium	5.7 a	8.3	28.3	56.7 ab	53.3 ab	50.0 bc
VL 3s' Festulolium	5.0 ab	12.3	31.7	50.0 abc	41.7 b	46.7 cd
3s" 11 Festulolium	6.3 a	7.3	25.0	56.7 ab	53.3 ab	50.0 bc
'Zoom' Perennial Rye	5.0 ab	5.0	16.7	31.7 c	35.0 b	31.7 d
LSD (α = 0.05)	**1.7**	**NS**	**NS**	**21.5**	**23.7**	**17.2**

Means followed by the same letter do not significantly differ (P=0.05). NS = Not significant

Table 3. Dry clipping weight (grams) of turfgrasses in response to deficit irrigation imposed on 29 June 2011. Riverside, CA.

Treatment	0 DAT	14 DAT	28 DAT	42 DAT	57 DAT	70 DAT
'Tulsa Time' Tall Fescue	45.4 a	15.7 a	5.1	3.9 b	5.8 b	4.0 b
'Laura' Meadow Fescue	53.5 a	13.4 a	7.6	6.3 a	11.8 a	11.2 a
'SR4220' Perennial Rye	21.6 bc	6.0 c	5.6	2.6 b	4.8 b	3.8 b
3s" 16 Festulolium	19.5 bc	7.2 bc	3.2	2.5 b	4.9 b	3.2 b
VL 3s' Festulolium	24.1 b	5.9 c	4.2	3.1 b	5.8 b	3.9 b
3s" 11 Festulolium	21.6 bc	11.5 ab	4.9	2.0 b	4.5 b	3.2 b
'Zoom' Perennial Rye	15.6 c	7.0 bc	3.3	2.9 b	3.3 b	3.3 b
LSD (α = 0.05)	**8.3**	**4.8**	**NS**	**2.1**	**4.7**	**3.3**

Means followed by the same letter do not significantly differ (P=0.05). NS = Not signific