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The use of native turf mixtures to approach sustainable lawn in urban landscapes

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ABSTRACT

Native grasses are excellent candidate species for manipulation to produce dwarf and turf type varieties as well as for producing cultivars with higher attractiveness and requiring less maintenance to be used as a turf grass in arid and semi-arid regions of the world. This investigation was conducted to explore visual qualities of native grasses and their mixtures compared to commercial turf. The field experiment was set out in a split-plot in time based on a randomized experimental design with three replications. We used two native monoculture accessions, perennial ryegrass (*Lolium perenne* L. 'Yarand') and (*Lolium perenne* L. 'Shadegan'), Native low-variety Mixture (NM1): consisting of 50% *Lolium multiflorum* 'Shadegan', 50% *Festuca* spp. 'Shadegan', Native high-variety Mixture (NM2): consisting of 55% *Lolium perenne* L. 'Yarand', 35% *Lolium perenne* L. 'Shadegan', 5% *L. multiflorum* 'Shadegan' and 5% *Festuca* spp. 'Shadegan' and compared this with one commercial turf mixture that is commonly used in landscaping. Results indicated the effects of seasons and turf grass types and their interaction had significant effects on most variables including quality, season color, leaf texture, density, quality after clipping ($p < 0.01$). The visual quality measurements indicated the superiority of *L. perenne* 'Shadegan' over other native monoculture and polyculture and its ablility to compete with the commercial turf. The native turf mixture of NM2 showed several good characteristics. *L. perenne* 'Yarand' had statistically the lowest score for visual appeal as compared with the other turf types. This research suggests that the use of native grass species of *L. perenne* 'Shadegan' is worth investigating for better performance of the native landscape.

Introduction

Turf grass plays a vital role in human life adding elegance to the environment and providing the foundation for many recreational sports and comprises a large portion of residential and commercial landscapes. One of the native landscaping options is the use of native turf, a blend of low-growing native grasses that provide a lawn-like appearance (Sauer, 1999; www.rainscapingiowa.org). Native plants are hardy because they have adapted to local conditions (Butler et al., 2012). Because maintaining native plants requires less work, they provide excellent choices for large commercial landscapes as well as residential gardens (Lady Bird Johnson Wildflower Center, 2013; www.wildflower.org). Turf breeders are searching to develop turf grass cultivars that can implement satisfactory growth in a wide range of climates, soils, and environmental conditions (Pessarakli and Kopec, 2008). These grasses are excellent candidate species for manipulation to produce dwarf and turf type varieties as well as producing cultivars which have more attractiveness and require less maintenance to be used as a turf grass in arid and semi-arid regions of the world. For these reasons there has been increasing attention toward the selection and propagation of native turf grasses which have demonstrated a variety of other beneficial traits (Bormann et al., 2001). Because of different growth patterns, a mixture of two or more grasses types may complement each other to provide both functional and esthetic improvements in turf quality.

There are several reports on the comparison and selection between different genotypes of turf grasses for color uniformity, wear tolerance and coverage (Skirde, 1989; Dunn et al., 1994; Newell et al., 1996; Salehi and Khosh-Khui, 2004). Salehi and Khosh-Khui (2004) compared different seed mixtures in the experimental field in Shiraz and reported that mixture of *Poa* with *Cynodon* had highest tiller density, root growth and chlorophyll content. They also showed that *Lolium* monoculture was not suitable in regard to low tiller density. Newell et al. (1996)

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Table 1
Monthly average precipitation and temperatures at the experimental site for January 2011 to December 2012.

	2011			2012		
Month	Max. average Temp (°C)	Min. average Temp (°C)	Precipitation (mm)	Max. average Temp (°C)	Min. average Temp (°C)	Precipitation (mm)
January	8.7	0.5	0	6.3	3.2	28
February	1.1	0.1	150	3	0.5	18
March	10.5	1.6	9.5	2.2	1.2	291.5
April	23.21	9.27	1.5	21.04	9.28	21
May	25.52	15	27.5	24.37	12.6	10.5
June	27.22	14.9	4.5	22.25	12.5	8.5
July	29.51	18.1	0	21.92	17.5	0
August	27.39	17.4	0	26.8	14.2	0
September	28.85	11.1	0	19.86	15.6	0.5
October	18.72	9.19	19.5	19.03	9.96	7.5
November	7	1.99	47.5	6.93	3.28	0.5
December	7.4	-1.55	0	0.11	0.01	0

recommended seed mixtures of *Lolium* and *Festuca* for having best wear tolerance. Skirde (1989) reported that *Festuca* had poor competitiveness against *Lolium* and *Poa.* Perennial ryegrass and tall fescue genotype were better than Kentucky bluegrass in coping with the Mediterranean environmental conditions (Martiniello and D'Andrea, 2006). Salehi and Khosh-Khui (2004) compared monoculture and mixture of different turfgrasses and showed that visual quality of mixture of *Festuca*, *Poa*, *Lolium* and *Cynodon* was better than individual species. The advantage of mixing species of *Festuca*, *Poa* and *Lolium* compared with individual species to reduce disease occurrence was evident on several occasions (Dunn et al., 2002).

The use of polycultures of native turfgrasses has not been extensively investigated (Simmons et al., 2011). Preliminary tests of any native turf grasses under real conditions would produce valuable results for breeders and urban landscape designers. So, the objectives of this investigation were to compare growth responses of native accessions in monoculture and their mixtures compared to commercial turf mixture and evaluate esthetic qualities, homogeneity (attractiveness) and yield among native grasses.

Materials and method

Experimental design and site description

This research project was conducted at the experimental farm of the Department of Horticultural Science, Agricultural College, Ferdowsi University of Mashhad, Mashhad, Iran, during 2011 and 2012 (59° 38′ E and 36° 16′ N; elevation 989 m; mean annual rainfall 255.2 mm). The local climate is arid and semi-arid. Long term averages of maximum and minimum temperature are 22 °C and 8.9 °C, respectively. The meteorological data of the experimental site is shown in Table 1. This research project was conducted in a split-plot in time based on completely randomized experimental design with three replications. Year seasons (autumn, winter, spring, summer) were considered as main plot and turf grass types as subplot.

Plant material

Turf grasses were comprising of:

1. Native monoculture: perennial ryegrass (*Lolium perenne* L. 'Yarand') and (*Lolium perenne* L. 'Shadegan'), which are two regionally native accessions from Yarand and Shadegan, respectively, in Esfahan Province, Iran.
2. Native low-variety mixture (NM1): consisting 50% *Lolium multiflorum* 'Shadegan', 50% *Festuca* spp.'Shadegan'.
3. Native high-variety mixture (NM2): consisting 55% *Lolium perenne* L. 'Yarand', 35% *Lolium perenne* L. 'Shadegan', 5% *L. multiflorum* 'Shadegan' and 5% *Festuca* spp. 'Shadegan'.These native seeds were supplied by Pakan Bazre Esfahan Ltd. Co.
4. Commercial mixture (CM) (NAk-Nederland): consisting 2% *Lolium perenne* BE, 33% *Lolium perenne* NL, 20% *Lolium perenne* DK, 35% *Poa pratensis* US and 10% *Festuca rubra* commutata FR.

Thus, turf grass treatments were abbreviated as *Lolium perenne* L. 'Yarand' = LPY, *Lolium perenne* L. 'Shadegan' = LPS and seed mixtures of NM1, NM2 and CM.

Culture and maintenance

Turf grass plots were established by directly sowing the seeds at autumn season in 2011. The rate of seedling was 40 g/m^{-2} for LPY, 25 g/m^{-2} for LPS, 28 g/m^{-2} for NM1, 33.5 g/m^{-2} for NM2 and CM according to seeds size and physical purity.

The soil characteristics was loamy texture, pH = 7.21, cation exchange capacity of 6.6 meq/100, organic matter of 0.9%.

Plots were prepared after plowing and leveling the soil. The plots were hand sown in plots of 1.2 m^2 (1 m × 1.2 m) and covered with a thin layer of leaf compost and manure. Irrigation was carried out daily (2 or 3 times a day) during establishment and then irrigation depths varied with daily reference evapotranspiration (ETo). Evaporation pan was used to estimate ETo; multiplying daily pan evaporation measurement by pan coefficient (K_p = 0.75 for the study area) yielded the reference evapotranspiration which equals to irrigation depth. Clippings number during experiment for single season is shown in Table 2. All weed species, both grasses and forbs, were hand pulled during the two years of study. In winter all plots were top dressed with a 3 to 6 mm mixed layer of sand and manure to increase cold tolerance and urea ($CO(NH_2)_2$) fertilizer (3 g/m^{-2}) was applied to each plot in spring.

Data collection

Visual quality was assessed using a visual score based on a 1–9 scale, as used in the National Turf grass Evaluation Program (NTEP) in the USA (Beard, 1973; Salehi and Khosh-Khui, 2004). The lowest level (1) defines very poor turf quality while the highest level (9) defines ideal visual quality. A rating of 6 or greater was considered

Table 2
Clippings number during experiment for single season.

clippings (no.)	
Autumn	2
Winter	0
Spring	5
Summer	5
Total cuts	12