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LOW MAINTENANCE TURF – QUALITY AND WEED ASPECTS

ABSTRACT

Turfgrass varieties of *Festuca rubra* ssp. *rubra*, *F.r.* ssp. *trichophylla*, *F. nigrescens*, *F. arundinacea*, *F. ovina* ssp. *vulgaris*, *F.o.* ssp. *duriuscula*, *Lolium perenne* and *Poa pratensis* as well as mixtures of high and low share of *Lolium perenne* were tested in low maintenance conditions during 5 years and evaluated for: shoot density, visual merit and for weed infestation. None of tested entries was able to keep initial quality. Only for few of them (mostly varieties of *Festuca ovina* ssp. *duriuscula* and *F. arundinacea*) visual merit after 5 years was still close to the level of minimal user-accepted value (5 in 1-9 scale). The least visual merit values were noted for *Poa pratensis* and *Festuca rubra* ssp. *rubra*. Twenty weed species of different living forms (geophytes, hemicryptophytes and terophytes) were described. Considering general turf performance, low number of weed species and low number of terophytes, turf mixtures with low share of perennial ryegrass could be recommended for low-maintenance turf.

Key words: *Festuca arundinacea*, *Festuca nigrescens*, *Festuca rubra*, *Festuca ovina*, *Lolium perenne*, low-input, cultivars, mixtures, *Poa pratensis*

INTRODUCTION

Along with increasing environment pollution, water deficits and other resources scarcity, demands for low input technologies in agriculture, gardening or other environment-related technologies are growing. Turf is often the most visible of plantings in urban areas and in many countries there is an increasing public pressure for the turfgrass industry to reduce maintenance inputs (Mintenko *et al.* 2002). Even under intensive management, the goal of turf sustainability is becoming more of a reality than a hope, as turfgrass scientists and managers have worked to identify turfgrass management systems that are more efficient, thus requiring less inputs. Low maintenance turf is therefore the only one reasonable possibility to cover large, municipal green areas due to its ecological role and potential resources savings.

Despite of turf quality aspects, little research is currently present on spontaneous weed infestation on turf areas, with regards on natural ‘defensive’

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ability of grass species to cope with weeds. Therefore, the aim of our studies was to evaluate turf quality of some turf grass varieties and mixtures, along with weed infestation under 5 years of low maintenance management.

Table 1
Species, varieties and mixtures used in experiment with species share during sowing

No.	Genus, species, mixture type (genus code)	Variety name, mixture no	Species share during sowing [%]					
			L.p.	F.r.	P.p.	F.o.	A.c.	F.a.
1		Bartes						100
2	<i>Festuca arundinacea</i> (F.a.)	Skarpa						100
3		Terros						100
4		Lifalla		100				
5	<i>Festuca nigrescens</i> (F.n.)	Nimba		100				
6		WOM-198		100				
7		Espro				100		
8	<i>Festuca ovina</i> ssp. <i>Duriuscula</i> (F.o.d.)	Gabi				100		
9		Mimi				100		
10		Livina				100		
11	<i>Festuca ovina</i> ssp. <i>Vulgaris</i> (F.o.v.)	Noni				100		
12		Witra				100		
13		Areta		100				
14	<i>Festuca rubra</i> ssp. <i>rubra</i> (F.r.r.)	Ensylva		100				
15		Leo		100				
16		Adio		100				
17	<i>Festuca rubra</i> ssp. <i>Trichophylla</i> (F.r.t.)	Barcrown		100				
18		WOM-298		100				
19		Lisuna	100					
20	<i>Lolium perenne</i> (L.p.)	Nira	100					
21		Stadion	100					
22		Conni			100			
23	<i>Poa pratensis</i> (P.p.)	Cynthia			100			
24		Limusine			100			
25		1	50	40	10			
26	mixture, high L.p. share (MixHLP)	2	60	25	15			
27		3	60	30	10			
28		4	0	88	5	5	2	
29	mixture, low L.p. share (MixLLp)	5	10	57	30		3	
30		6	5	45	25	25		

Explanation: A.c. – *Agrostis capillaris*, F.r. – *Festuca rubra* sensu lato, F.o. – *Festuca ovina* sensu lato

MATERIALS AND METHODS

Turf experiment on 24 turf grass varieties and 6 commercial turf mixtures was carried out from 2002 to 2006 (Table 1). Experiment was conducted in

central Poland, on lessive, sandy-loam soil. Area planned for this experiments laid fallow for 4 years, with frequent surface cultivation to reduce weeds emerging from seed soil bank. Starting fertilization (60 kg N, 120 Kg P, 120 kg K per ha) was applied and grass seed was sown in April of 2001 on randomized plots (1m²) in 3 replications. Sowing quantities, (expressed in grams per 1m²) ranged from 10 for *Poa pratensis*, 15 for *Festuca rubra*, *F. ovina*, *F. nigrescens*, 20 for *Lolium perenne*, *Festuca arundinacea* and 25 for all turf mixtures. Turf plots were further managed without fertilization, with mowing at 7–10 cm, ca. 10 times a year with clippings collected, watered only during heavy drought and with no chemical weed control. Visual merit (VM) and shoot density (SD) were evaluated 5 times a year (early spring, spring, summer, autumn and winter) using 1–9 scale. For VM rating value of 9 is reserved for a perfect or ideal grass, rating of 6 is generally considered acceptable and 1 – poorest (Morris and Sherman, 2007). For shoot density 9 means maximum density (100%), 7 – ca. 80% of ground covered by leaves and tillers, 5 – ca. 60%, 3 – ca. 20% and 1 – 0%, no green cover (Prończuk, 1993). For the purpose of above work, yearly means of SD and VM from 2002 and 2006 were only given and further analyzed. Weed cover (WC) expressed as a% of plot cover by weed species (i.e. dicotyledonous plant species and grasses not sown) was assessed in autumn of 2003 and 2006, and average number of weed species (NWS) per entry was calculated. All data were subjected to arcsine transformation for better approximation to normal distribution prior to statistical analysis performed with SAS[®] statistical package. Least significant difference (LSD) was performed with Fisher test (P = 0.05).

RESULTS AND DISCUSSION

One from the most important traits for low maintenance turf is the ability to cover ground, which is of great utilitarian purpose of stabilizing soil (reduction of dust, mud or weed problems) (Diesburg *et al.* 1997). Ground cover was not directly evaluated in our experiment, however it could be indirectly expressed by means of shoot density (SD). Mentioned trait decreased for most of tested entries after 5 years of low maintenance management (Table 2). Low reduction of SD was noted for *Festuca ovina* ssp. *duriuscula* ESPRO and all mixtures with low share of *Lolium perenne* (86.5 and 82.9% of initial value, respectively). In contrast, high SD reduction was observed for *Festuca nigrescens* LIFALLA, mixture no. 2 (high share of *Lolium perenne*) and *Festuca nigrescens* WOM-198 (62.5, 64.0 and 65.1% of initial value, respectively).

Visual merit (VM) of tested entries also decreased with different rates after 5 years. Relatively low decrease of VM (range from 86.4 to 82.0% of initial value) was noted for all *Festuca ovina* ssp. *duriuscula* cultivars as well as for *Festuca arundinacea* SKARPA and TERROS, and two mixtures of

Table 2.

Results of observation on shoot density (SD), visual merit (VM) and weed infestation

Species code, variety or mixture, name	SD			VM			WC [%]					WC for species [%]			NWS
	2002	2005	2006	2002	2005	2006	2003	2006	Taraxac. official.	H	T	G			
1	2	3	4	5	6	7	8	9	10	11	12				
F.a. Bartes	7.2	4.8	7.1	5.2	8.3	32.5	5.8	13.3	17.5	1.7	3.7				
F.a. Skarpa	6.2	4.8	6.1	5.0	10.0	47.5	12.5	39.2	7.5	0.8	4.7				
F.a. Terros	6.3	4.7	5.9	4.8	6.7	27.5	10.8	18.3	8.3	0.8	4.3				
Mean for F.a.	6.6	4.8	6.4	5.0	8.3	35.8	9.7	23.6	11.1	1.1	4.2				
F.n. Lifalla	7.5	4.7	7.1	2.8	5.0	14.2	10.0	11.7	2.5	0.0	2.3				
F.n. Nimba	8.0	5.5	7.5	4.0	11.7	80.7	52.7	65.3	11.2	4.2	5.0				
F.n. WOM-198	7.9	5.2	7.7	4.0	11.7	43.3	15.0	23.3	13.3	6.7	5.7				
Mean for F.n.	7.8	5.1	7.4	3.6	9.4	46.1	25.9	33.4	9.0	3.6	4.3				
F.o.d. Espro	6.9	6.0	6.1	5.7	1.0	29.2	6.7	16.7	10.0	2.5	5.0				
F.o.d. Gabi	7.1	5.7	6.4	5.3	3.3	60.5	25.2	44.3	16.2	0.0	5.0				
F.o.d. Mimi	7.3	5.5	6.4	5.3	7.3	42.5	10.0	30.0	11.7	0.8	4.0				
Mean for F.o.d.	7.1	5.7	6.3	5.4	3.9	44.1	13.9	30.3	12.6	1.1	4.7				
F.o.v. Livina	6.9	5.2	6.1	4.0	13.3	59.8	25.2	50.3	8.7	0.8	5.3				
F.o.v. Noni	7.5	5.2	6.6	4.5	10.3	29.2	1.7	16.7	11.7	0.8	3.7				
F.o.v. Sima	6.6	5.2	5.8	4.0	11.7	26.7	10.8	18.3	7.5	0.8	4.0				
Mean for F.o.v.	7.0	5.2	6.2	4.2	11.8	38.6	12.6	28.4	9.3	0.8	4.3				
F.r.r. Areta	6.6	5.0	6.2	3.7	16.7	58.3	25.8	45.8	11.7	0.8	4.3				
F.r.r. Ensylva	7.2	5.0	6.8	3.0	5.0	72.5	42.5	59.2	11.7	1.7	4.7				
F.r.r. Leo	6.9	5.0	6.3	3.7	15.0	40.8	18.3	24.2	15.8	0.8	5.0				
Mean for F.r.r.	6.9	5.0	6.4	3.4	12.2	57.2	28.9	43.1	13.1	1.1	4.7				

Table 2.
Results of observation on shoot density (SD), visual merit (VM) and weed infestation (continued)

	1	2	3	4	5	6	7	8	9	10	11	12
F.r.t. Adio		6.9	5.2	6.6	4.0	10.0	57.5	25.8	31.7	15.8	10.0	5.3
F.r.t. Barcrown		8.4	5.5	7.8	4.2	5.0	68.2	40.2	57.8	10.3	0.0	4.0
F.r.t. WOM-298		8.1	5.5	7.6	4.5	5.3	54.2	17.5	34.2	19.2	0.8	4.3
Mean for F.r.t.		7.8	5.4	7.3	4.2	6.8	59.9	27.8	41.2	15.1	3.6	4.6
L.p. Lisuna		6.8	5.0	6.3	4.7	15.0	36.7	6.7	18.3	17.5	0.8	3.3
L.p. Nira		6.2	4.5	5.8	4.5	18.3	45.0	14.2	26.7	17.5	0.8	5.0
L.p. Stadion		6.7	4.8	6.3	4.7	15.0	40.0	18.3	26.7	11.7	1.7	4.7
Mean for L.p.		6.6	4.8	6.1	4.6	16.1	40.6	13.1	23.9	15.6	1.1	4.3
P.p. Conni		7.6	5.2	7.3	3.7	15.0	57.5	33.3	38.3	19.2	0.0	5.3
P.p. Cynthia		6.6	4.3	5.6	2.7	20.0	81.7	42.5	66.7	10.0	5.0	5.3
P.p. Limusine		7.6	5.0	6.5	3.7	10.0	65.0	34.2	51.7	10.8	2.5	4.7
Mean for P.p.		7.2	4.8	6.4	3.3	15.0	68.1	36.7	52.2	13.3	2.5	5.1
MixHLP 1		6.1	5.0	5.9	4.8	30.0	38.8	20.0	28.8	8.8	1.3	3.5
MixHLP 2		6.4	5.0	6.2	4.8	5.0	37.5	26.3	27.5	10.0	0.0	3.0
MixHLP 3		6.3	4.0	6.2	4.8	12.5	31.3	20.0	22.5	7.5	1.3	3.0
Mean for HLP		6.2	4.7	6.1	4.8	15.8	35.8	22.1	26.3	8.8	0.8	3.2
MixLLP 1		6.1	5.0	5.8	4.8	3.5	61.3	50.0	51.3	8.8	1.3	3.0
MixLLP 2		6.6	5.5	6.4	4.8	6.0	45.0	26.3	36.3	7.5	1.3	3.5
MixLLP 3		6.1	5.0	5.9	4.8	5.0	36.3	26.3	35.0	0.0	1.3	2.5
Mean for LLP		6.2	5.2	6.0	4.8	4.8	47.5	34.2	40.8	5.4	1.3	3.0
General mean		7.0	5.0	6.4	4.2	10.8	48.1	22.9	35.0	11.4	1.7	4.3
LSD for species (P>95%)		0.42	0.51	0.43	0.74	6.5	27.4	18.5	n.s.	n.s.	n.s.	1.1

Explanation: H – hemipterophytes, T – terophytes, G – geophytes, WC – weed cover, NMS – number of weed species

low share of *Lolium perenne* (no. 4 and 5). High quality of tall and sheep fescue in low-maintenance was also confirmed by others (Dernoeden *et al.* 1998; Diesburg *et al.* 1997; Brede 2000). High VM decrease (ca. 50% or more than initial value) was noted for all *Poa pratensis* cultivars, *Festuca nigrescens* LIFALLA and *Festuca rubra* ssp. *rubra* ENSYLVA. Turfgrass varieties and species are known to differ in their performance under reduced maintenance (Brede, 2000).

Table 3.
Weed species identified and weed cover values (WC) after 4 years on low-maintenance

No.	Genus, species, authority	Living form	WC [%]		
			Average	Range	Standard deviation
1	<i>Taraxacum officinale</i> Weber	H	22.4	0 - 62.5	20.02
2	<i>Trifolium campestre</i> Schreber	T	9.19	0 - 37.5	8.55
3	<i>Trifolium repens</i> L.	C	6.48	0 - 37.5	10.48
4	<i>Hieracium pilosella</i> L.	H	3.03	0 - 28	4.47
5	<i>Equisetum arvense</i> L.	G	1.63	0 - 37.5	4.01
6	<i>Helichrysum arenarium</i> (L.) Moench	H	0.74	0 - 15	2.43
7	<i>Hypericum perforatum</i> L.	H	0.55	0 - 2.5	1.04
8	<i>Plantago lanceolata</i> L.	H	0.41	0 - 2.5	0.93
9	<i>Conyza canadensis</i> (L.) Cronq.	T, H	0.27	0 - 2.5	0.77
10	<i>Erucastrum gallicum</i> (Willd.) O. E. Schulz	T, H	0.25	0 - 2.5	0.75
11	<i>Cichorium intybus</i> L.	H	0.16	0 - 2.5	0.61
12	<i>Diploaxis muralis</i> (L.) DC.	T	0.13	0 - 2.5	0.55
13	<i>Dactylis glomerata</i> L.	H	0.09	0 - 2.5	0.48
14	<i>Solidago canadensis</i> L.	H, G	0.08	0 - 2.5	0.44
15	<i>Vicia cracca</i> L.	H	0.06	0 - 2.5	0.39
16	<i>Lotus corniculatus</i> L.	H	0.05	0 - 2.5	0.34
17	<i>Astragalus glycyphyllos</i> L.	H	0.03	0 - 2.5	0.28
18	<i>Hypochoeris glabra</i> L.	T	0.03	0 - 2.5	0.28
19	<i>Artemisia vulgaris</i> L.	C	0.02	0 - 2.5	0.20
20	<i>Cirsium arvense</i> (L.) Scop.	G	0.02	0 - 2.5	0.20

Explanation for living forms: H – hemicryptophyte, T – terophyte, G – geophyte, C – chamephyte

Total number of 20 weed species was identified, most of them (75%) perennials, with no statistical difference of species cover between replications and tested entries (Tables 2, 3). However, for turf grass species, significant differences were calculated for 14 of all identified weed species. Average number of weed species was the highest for *Poa pratensis* (5.1) but the lowest for turf mixtures (3.0 – 3.2). Weed cover (WC) values were the

highest for *Poa pratensis* and *Festuca rubra* ssp. *trichophylla* (68.1 and 59.9%, respectively) and the lowest for mixtures of high share of *Lolium perenne*, *Festuca arundinacea* (35.8% for both), *Festuca ovina* ssp. *vulgaris* and *Lolium perenne* (38.6 and 40.6%, respectively). Similar results concerning weed infestation of *Poa pratensis*, *Lolium perenne*, *Festuca ovina*, *F. arundinacea* were obtained in low maintenance turf trails in Canada by McKernan and Ross (1993; 1996 after Brede 2000).

Weeds of the highest WC values were: *Taraxacum officinale* Weber (22.8%), *Trifolium campestre* Schreber (9.2%), *T. repens* L. (6.5%) and *Hieracium pilosella* L. (3.0%). Despite of the lack of statistically significant differences between entries, the lowest *Taraxacum* cover was noted for: *Festuca ovina* ssp. *vulgaris* NONI, *Festuca arundinacea* BARTES, *Festuca ovina* ssp. *duriuscula* ESPRO, and *Lolium perenne* LISUNA (1.7, 5.8, 6.7, 6.7%, respectively). The highest *Taraxacum* cover were observed on *Festuca rubra* ssp. *trichophylla* BARCROWN, *Poa pratensis* CYNTHIA, *Festuca rubra* ssp. *rubra* ENSYLVA, mixture no. 4 (low share of *Lolium perenne*) and *Festuca nigrescens* NIMBA (40.2, 42.5, 42.5, 50, 52.7%, respectively). Probably due to its highest cover values, *Taraxacum* was the only species that negatively affected final VM value ($r = -0.42^{**}$).

Weed cover increased over time, but with different magnitudes. High increase ($WC_{2006} - WC_{2003}$) was noted for *Festuca rubra* ssp. *trichophylla*, *Poa pratensis* and mixtures of high share of *Lolium perenne*, as well as for cultivars of *Lolium perenne* and *Festuca ovina* ssp. *duriuscula* (20.0, 24.5 and 26.8%, respectively).

Weeds on low managed turfs are in many cases dominating components of sward. Weed infestation on Warsaw city turfs ranged from 41 to 76% (Wysocki, Stawicka 2000). Relatively high share of terophytes (annual species) in our experiment is similar to results obtained by Wysocki and Stawicka (2000). Such relation is negative for turf, but we have noticed relatively low values of terophytes cover in mixtures of low share of *Lolium perenne* (5.4%) as compared to other entries (range from 8.8 for mixtures of high share of *Lolium perenne* to 15.6% for *Lolium perenne*). Geophytes and hemicryptophytes accounted for majority (70%) of identified weed species. It was also confirmed also by Wysocki (1994) and Wysocki and Stawicka (2000) on turf areas in parks.

Turf weed infestation is differently affected by irrigation, fertilization and mowing (Fry, Huang 2004). Water is necessary to germination and emergence of weeds, but each year it is quite narrow 'window' during which winter or summer annuals emerge. Therefore, if low maintained areas are not artificially watered, annual weeds invasion will not be stimulated. Turf receiving inadequate levels of fertilizers, especially nitrogen, is generally not resistant to weed invasion. Nitrogen fixing weeds as clovers could be therefore quite frequent, as in our experiment (15.7% of weed

cover). In contrast, mowing with clippings collected may reduce weed populations, mostly of seed producers (Fry and Huang 2004).

Weeds on large, low managed municipal areas (parks, gardens, cemeteries etc.) are inherent component of turf. However, still much has to be done to balance the share of weeds and grasses on turf sward. Otherwise, turf will no longer be green area but the initial stage of succession of unpredictable direction.

CONCLUSIONS

None of tested varieties and mixtures was able to keep initial values of shoot density and visual merit after 5 years of reduced maintenance.

Despite of initial differences in visual merit, turf mixtures were very similar after given time of experiment with no differences inside or between group of mixtures.

Turf mixtures of low share of *Lolium perenne* should be recommended for low maintenance turfs due to its relatively high turf quality, high ability to cope with weeds and known significantly lower input requirements considering mowing.

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