THE IMPACT OF DIFFERENT AGRO-ECOLOGICAL CONDITIONS ON SOD WEIGHT AND STRUCTURE OF SELECTED TURF GRASS SPECIES

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INTRODUCTION

Landscape turfs constitute a vegetation component, the lack or possibly low quality and neglected condition of which belong among the key environmental issues for cultural landscapes and human settlements. Achieving and maintaining functional efficiency of grass areas is directly related to a wide complex of growing actions and measures. By the intensiveness and frequency of such actions, a growing technology is developed that respects the requirements put on particular types of turf while considering the stress factors affecting the sod. In the most of park grass mixtures seeded, *Lolium perenne*, *Festuca rubra*, and *Poa pratensis* are the base species affecting duration, density, health, resistance to drought, colour, and other performance and aesthetic traits of non-production grass areas depending on the particular percentage in the mixture. (Straková, Hrabě, 2001.)

The quality and overall appearance of the sod is mainly determined by a sod structure, i.e. the percentage of a withered component and plant remnants, the percentage of a live component with active photosynthesis, and a root system. Root biomass forms 60 - 90% of the net primary production of grass ecosystems. The larger quantity of active roots means that reserve substances developed and higher resistance of the stand to changes of external conditions as well as stress factors. The longevity of the roots, rooting depth, and weight and stratification of a root system show great species- and strain-specific variations that can be modified depending on the site, level of treatment, and stress impact. The deeper the roots stretch, the better moisture they can get, even from a greater depth, thus resisting the stress' caused by drought. Beside the root depth, soil rootness that has recently become a subject of root biomass studies is another important criterion. According to Beard (1973), moderate zone grass root systems can reach a depth of around 45 cm.

This paper evaluates the impact of the effect of different agro-ecological conditions on three climatically different sites on sod development and structure, i.e. residual aerial biomass and root biomass, in 5-mow grass growth of base grass species, *Lolium perenne*, *Festuca rubra*, and *Poa pratensis*, in relation to the application of nitrogen in fertilizer in forms with different actions and in relation to the application of different levels of nitrogen rate in the course of two cropping years.

METHODS

The polyfactorial small-plot experiment was established using a randomized controlled trial method in three repetitions on three climatically different sites in September 2006; see Tab.1.

Table 1: Basic climate and soil features of the sites.

Locality	Soil sort	Soil type	Altitude (M)	Annual rainfall	Mean daily air temperature
Rousínov	Loamy soil	Fluvisoil	229	511 mm	9.0 °C
Zubří	Sandy-loamy soil	Alluvial soil	345	865 mm	7.5 °C
Vatín	Sandy-loamy soil	Cambisoil	560	618 mm	6.9 °C

From each option of extensive turfs composed of *Lolium perenne* (30%), *Poa pratensis* (30%), and *Festuca rubra* (40%), a solid piece of sod was collected using a sampling trier to a soil depth of 200 mm and residual aerial biomass height of 40 mm immediately upon the last, 5th mowing at the end of the vegetation season. The plot size was 1.8 x 1.8 m^2. For seeding, a quantity of 25 $g.m^{-2}$ of seed was used. When sampling the roots using the monolith method (Fiala in Rychnovská et. al., 1987), the basis for evaluating the weight of live and withered residual aerial dry matter production and the weight of the root dry matter production in the layer from 0 to 200 mm was obtained. The data (in particular days) were evaluated with the analysis of variance ANOVA Tukey test α = 0.05 (Statistika programme, Version 8).

RESULTS

The results of each sod component from two cropping years imply the essential impact of a site on not only the weight of the tested traits, but in particular on the sod structure. In Cropping Year 1, i.e. 2007, statistically significant higher values of dried root biomass were achieved in the soil layer 20 to 200 mm on the Vatín site located in the highest altitude, 560 m (Table 1) with the lowest mean daily temperature, 6.9 °C compared to other sites at lower altitudes: 429.24 g. m^{-2} in *Lolium perenne*, 426.08 g. m^{-2} in *Festuca rubra*, and 327.81 g. m^{-2} in *Poa pratensis*. In Cropping Year 2, the variations in the root layer 20 to 200 mm were even more statistically significant, with up to fourfold differences among the sites. In 2008, in every type of tested stand a stagnation or even increase in weight of the root biomass occurred in the layer 20 to 200 mm on the Vatín and Zubří sites, in the driest site, i.e. Rousínov in South Moravia, the root development of *Lolium perenne* and *Festuca rubra* in the same layer even decreased when compared to the previous year, 2007.

Species featuring a supranormal total weight of root biomass include *Festuca ovina*, *Poa pratensis* and *Festuca rubra* according to Straková (2001), which was confirmed by the result history of this experiment as well. The highest mean values of the total weight of root biomass were achieved on the Vatín site in Cropping Year 2, in the *Festuca rubra* (1120 $g.m^{-2}$) and *Poa pratensis* (1234 $g.m^{-2}$) species.

When evaluating the residual aerial biomass, statistically significant differences among the sites in Cropping Year 2 were only found in the *Lolium perenne* and *Poa pratensis* stands, in the development of both live and withered residual aerial biomass; Tables 2 and 4. In the *Festuca rubra* stand, the result history does not imply any impact of a different agro-ecological site on the development of the residual aerial biomass; Table 3.

Table 2: Impact of different agro-ecological conditions on the mean values of different parts of sod in the *Lolium perenne* stand in Cropping Year II. (The different letters between the lines mean a statistical difference on the significance level of $p \leq 0.05$ for Tukey HSD test.)

Site	Live aerial biomass [$g.m^{-2}$]		Withered aerial biomass [$g.m^{-2}$]		Roots in the layer 0-20 mm [$g.m^{-2}$]		Roots in the layer 20-200 mm [$g.m^{-2}$]	
Rousínov	230.50	a	507.80	a	332.09	a	135.64	a
Vatín	225.42	a	343.59	a	576.52	b	420.50	b
Zubří	126.09	b	120.50	b	316.13	a	252.94	c

Table 3: Impact of different agro-ecological conditions on the mean values of different parts of sod in the *Festuca rubra* stand in Cropping Year II. (The different letters between the lines mean a statistical difference on the significance level of $p \leq 0.05$ for Tukey HSD test.)

Site	Live aerial biomass [$g.m^{-2}$]		Withered aerial biomass [$g.m^{-2}$]		Roots in the layer 0-20 mm [$g.m^{-2}$]		Roots in the layer 20-200 mm [$g.m^{-2}$]	
Rousínov	86.331	a	402.70	a	366.48	a	133.31	a
Vatín	165.97	a	397.69	a	582.35	b	538.91	b
Zubří	126.57	a	265.16	a	434.55	ab	387.75	c

Table 4: Impact of different agro-ecological conditions on the mean values of different parts of sod in the *Poa pratensis* stand in Cropping Year II. (The different letters between the lines mean a statistical difference on the significance level of $p \leq 0.05$ for Tukey HSD test.)

Site	Live aerial biomass [$g.m^{-2}$]		Withered aerial biomass [$g.m^{-2}$]		Roots in the layer 0-20 mm [$g.m^{-2}$]		Roots in the layer 20-200 mm [$g.m^{-2}$]	
Rousínov	144.18	a	550.70	a	542.63	a	180.73	a
Vatín	282.44	b	412.50	a	811.16	b	423.66	b
Zubří	140.02	a	139.54	b	456.24	a	256.26	a

CONCLUSIONS

The Rousínov site is becoming increasingly threatened by drought every year, and despite it being placed among the most fertile areas of the Czech Republic in terms of agronomy, there is a question whether the composition of the mixtures in establishing grass surfaces in South Moravia that has been based on the already established grass species of the moderate zone, i.e. *Lolium perenne*, *Festuca rubra* and *Poa pratensis*, was adequate in the context of the result history of this experiment and the course of climatic conditions on this site in recent years, and whether the species structure of the grass mixtures should be modified with additional regard to other tested grass properties such as colour, density, and overall appearance of the growth towards thermophile plants of type C4 or not.

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