Original Paper

The effect of Stockosorb® 500 Micro on the growth-production process of *Festuca arundinacea* Schreb.

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The aim of this paper was to determine the effect of different doses of Stockosorb® 500 Micro on the growth-production process of *Festuca arundinacea* Schreb. cv. Koreta. The pot experiment was realized in laboratory conditions in year 2010. There were used pots with volume 2 dm^3 and area on top 0.014 m^2 and 3 levels of the amount of Stockosorb® 500 Micro in experiment: 0 g.m^{-2}, 50 g.m^{-2} and 100 g.m^{-2}. Quantity of seeds was 1.18 g per pot (i. e. 40,000 seeds per m^2). Each treatment had 4 replications. Irrigating of pots was with 150 ml water per pot 2 times a week. Results of observations showed a statistically significant effect of Stockosorb® 500 Micro on daily intensity of growth to the height ($p = 0.040$), the total harvest of aboveground phytomass ($P = 0.000$) and non-significant effect on the intensity of the production of aboveground phytomass ($P = 0.084$). Stimulatory effect on indicators of the growth-production process of *Festuca arundinacea* Schreb. cv. Koreta had only Stockosorb® 500 Micro at dose 50 g.m^2. Application of 100 g.m^2 of Stockosorb® 500 Micro inhibited growth and production of that grass species, but with lower variability of average daily gain of height (*ADGh*), average daily gain of weight (*ADGw*) and thickening lawn index (*TLI*) values. Lower daily intensity of growth and phytomass production and higher turf density (expressed as thickening lawn index) is positively evaluated from the viewpoint of lawn management.

Keywords: average daily gain of weight, average daily gain of height, thickening lawn index, *Festuca arundinacea*, lawn

1 Introduction

In an urban country with high concentration of population, excessive industrialization and low levels of natural and semi-natural ecosystems, ecosystem services are overused. The ecological footprint is consequently greatly increases and deepens its ecological deficit. To mitigate the negative impacts of a high ecological footprint it is possible to use planting of green areas – lawns. These areas successfully supplement the missing natural ecosystems, contribute to the sustainable development of the city, strengthen the territorial system of ecological stability and significantly increase the biodiversity of the residential and industrial landscape (Tomaškin and Tomaškinová, 2012). However, in the current period of global climate changes we have to be deal with the problem of moisture deficit. It has negative effect on the resulting turf quality and functionality. Several authors (Černoch, 2003; Hatfield, 2017) reported the appropriate selection of drought-resistant grass species (for example *Festuca arundinacea* Schreb.), or use of warm-season grasses in turf, enrichment of turf mixtures about small-leaved *Trifolium repens* L. varieties as a way to eliminate the adverse impact of climatic changes on lawn growth. Another option is to use soil conditioners known as hydroabsorbents. They improve the physical properties of soil and substrates used in turf establishment. Due to its ability to bind more than 100-fold amount of water increase water capacity of the soil and thus contribute to reducing the cost of irrigation and improve the exploitability of nutrients from fertilisers (Hrabě et al., 2009). Hydroabsorbents support the growth of the root system, which creates conditions for better recovery and overall appearance of lawns at lower inputs. The function of the hydroabsorbents is also creating a larger and more stable soil aggregates on the basis of agglutinative effects (Salaš and Sloup, 2007). They have application in grassing of extreme habitats (Straka and Straková, 2003), improving the physical properties of degraded or problematic soils (dry sand) (Yang et al., 2014; Schmid et al., 2017), where their effect manifests itself clearly positive. Some authors (Waddington et al., 1974; Gregorová and Ďurková, 2006; Baker et al., 2010) reported positive effect of

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hydroabsorbent on aboveground and underground (root) phytomass production, number of tillers and plant height of selected turfgrass species. Similarly positive effect of hydroabsorbent found out Al-Humaid (2005) on the plant formation, robustness and depth of lawn root system. Chen et al. (2016) states that hydroabsorbents, which are widely used to maintain soil moisture in agriculture, can cause damage to plants. However, their mechanism of action is not well understood yet.

The aim of this scientific and research work was to evaluate the effect of Stockosorb® 500 Micro on selected growth-production characteristics of *Festuca arundinacea* Schreb. cv. Koreta.

2 Material and methods

Pot experiment was realized in laboratory conditions (temperature 20 °C, *rh* = 60–70%) at the Department of grassland ecosystems and forage crops, FAFR – SUA Nitra, Slovakia from April to October 2010. Turf was grown on 7 April 2010 in the containers with volume 2 dm^3 and area on top 0.014 m^2, in 4 replicates. There were 3 variants in this experiment:

- variant 1 (Control): without Stockosorb® 500 Micro (in next text as Stockosorb);
- variant 2 (S50): Stockosorb in a dose of 50 $g.m^{-2}$ (0.72 $g.container^{-1}$);
- variant 3 (S100): Stockosorb in a dose of 100 $g.m^{-2}$ (1.44 $g.container^{-1}$).

Used hydroabsorbent (Stockosorb® 500 Micro) is a polymer of natural substances with effect up to several years. It has the ability to retain water in an amount of more than 100-times its volume, improves soil structure and prevents it from overwetting (Gregorová, 2009; Hrabě et al., 2009).

In the experiment was used *Festuca arundinacea* Schreb. cv. Koreta with sowing quantities approximately 40,000 seeds per m^2 (i.e. 1.18 g of seed per pot). Amount of Stockosorb was mixed with the fluvisoil (its chemical properties are shown in Table 1) before sowing according to variants. At the same time in all variants was applied Duslofert lawn fertiliser (NPK: 15 – 15 – 15) at a dose of 0.43 g per pot (45 $kg.ha^{-1}$ N). In the next period turfs were not fertilised. Based on the general recommendations (Hrabě et al., 2007; Sulvis and Root, 2017) we chose to irrigate with the dose 150 ml water per pot 2 times a week (Tuesday and Friday).

Lawn was cut with scissors at a mean height of 100 mm at 50 mm. Before each cutting was determined height of turf as an average of 10 measurements in each replication. The average daily gain of height (mm per day) was calculated as:

$$ADGh = (\textit{mean height of turf at cutting in mm} - 50\ \text{mm})/\Delta t$$

where:

ADGh – average daily gain of height
Δt – days of growth

Cut aboveground phytomass was drying at 105 °C to constant weight and then was weighted to determine the production. Total aboveground phytomass harvest ($g.m^{-2}$) was determined as the sum of weights of phytomass from individual collections. The average daily gain of phytomass weight ($g.day^{-1}.m^{-2}$) was calculated as:

$$ADGw = \textit{mean production of phytomass at collection}\ \text{in g.m}^{-2} / \Delta t$$

where:
ADGw – average daily gain of weight
Δt – days of growth

Thickening lawn index (*TLI*) ($g.m^{-2}.mm^{-1}$) was determined as the ratio of *ADGw* and *ADGh*.

Data were statistically evaluated by Statistica 7.1 Complete CZ (Statsoft, Inc. 2005) using one-way analysis of variance (ANOVA). To assess the differences between variants was used Fisher`s LSD test at $P \leq 0.05$. On the graphical evaluation of the results was used MS Excel.

3 Results and discussion

The values of the *ADGh* show that the applicated Stockosorb had statistically significant (P = 0.040) influence on the rate of *Festuca arundinacea* Schreb. cv. Koreta growth (Figure 1). High growth intensity (7.71 mm per day) was noted on the variant S50. Higher dose of Stockosorb (100 $g.m^{-2}$) had inhibitory effect, which led to a reduction in the daily growth rate on average for the evaluated period (5.52 mm per day).

According to the classifier for the *Poaceae* family (Ševčíková et al., 2002), we can assess turfs in variants classify as "intense" to "very intense" growing. From

Table 1 Agrochemical composition of the soil used in the experiment

N_t	P	K	Mg	Ca	Na	C_{ox}	pH
$mg.kg^{-1}$						$g.kg^{-1}$	–
2,282.00	54.00	350.00	680.00	4,900.00	40.00	20.82	7.09

viewpoint of turf mowing management is request to uniform growth of grass (Turgeon, 2002; Harper, 2007). Therefore, it can be a higher dose of Stockosorb (S100) considered for more appropriate. In this variant was recorded the lowest variability of the average daily gain of height expressed by the standard deviation (*SD* = 3.04) compared to the other variants (*SD* = 3.62; *SD* = 3.65).

Average daily gain of weight of dry aboveground phytomass (Figure 2) had the same tendency as the intensity of growth in height, with a non-significant effect ($p = 0.084$). Stimulative effect had only lower dose of Stockosorb (S50), which increased the daily production of the phytomass by 0.36 g.day^{-1}.m^{-2}, and 1.01 g.day^{-1}.m^{-2} compared to control and the variant with dose of Stockosorb 100 g.m^{-2}, respectively. However, in terms of turfgrass management, where one of the objectives is the lowest intensity of phytomass production while maintaining the required quality of lawn (Ševčíková, 2002; Harper, 2007; Hrabě et al., 2009), consider as positive effect of higher dose of Stockosorb (S100).The daily production of phytomass was in this variant evenly, which is documented by the lowest value of the standard deviation (*SD* = 1.12) compared with the other variants (*SD* = 1.44).

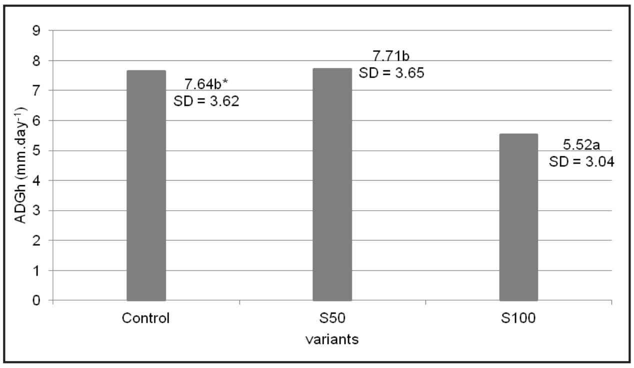

Figure 1 Average daily gain of height (*ADGh*) (mm.day^{-1}) in individual variants
Control – without hydroabsorbent; S50 – hydroabsorbent 50 g.m^{-2}; S100 – hydroabsorbent 100 g.m^{-2}; *SD* – standard deviation
*The different letters at an average values mean statistically significant difference (Fisher`s LSD test, $P \leq 0.05$)

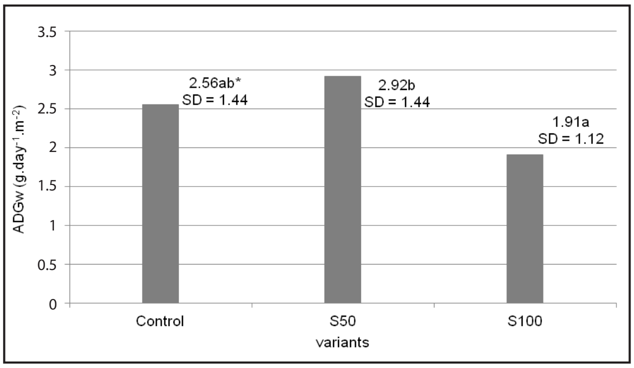

Figure 2 Average daily gain of weight (*ADGw*) of dry aboveground phytomass (g.day^{-1}.m^{-2}) in individual variants
Abbreviations see Figure 1

Density is an important qualitative indicator of all the lawns. In ornamental lawns it interacts their aesthetic appearance, in the soil-protective lawns is important from anti-erosion viewpoint, in sports turf contributes to the formation of a strong and flexible sod etc. (Hrabě et al., 2009). Therefore, for the evaluation of turfs quality can also use mutual ratio of the *ADGw* and *ADGh*. It is so called thickening lawn index (*TLI*), which is in positive correlation with the density of turf (i.e. the number of tillers per unit area). Higher values of *TLI* mean more phytomass per unit area in conversion on the unit of plant height – turf is denser (Kovár et al., 2012). The values of this indicator presented in Figure 3 show non-significant differences ($p = 0.600$) between variants. However, it can be said that better effectiveness had lower dose of Stockosorb (S50). It resulted in an increase in turf density by 0.06 g.m^{-2}.mm^{-1} and 0.05 g.m^{-2}.mm^{-1} compared to control and variant with dose of Stockosorb 100 g.m^{-2}, respectively. Also the experiment results of Gregorová et al. (2007) and Vozár and Kovár (2010) showed stimulatory effect of Stockosorb on the turf density.

A qualitative indicator of lawn can also be the total harvest of aboveground phytomass per growing season. For lawn establishment is better use the species (eventually varieties) having a total low phytomass production (Murphy, 1996; Turgeon, 2002), thus eliminating the problem of what to do with mown material (aboveground phytomass). From the values of the total harvest of aboveground phytomass resulted that used Stockosorb had statistically significant ($P = 0.000$) effect on the total harvest of dry aboveground phytomass (Figure 4). It was more than 40 g.m^{-2} of phytomass after application of Stockosorb at a dose of 50 g.m^{-2} in comparison with the control (without hydroabsorbent). According to the classifier for the *Poaceae* family (Ševčíková et al., 2002) it

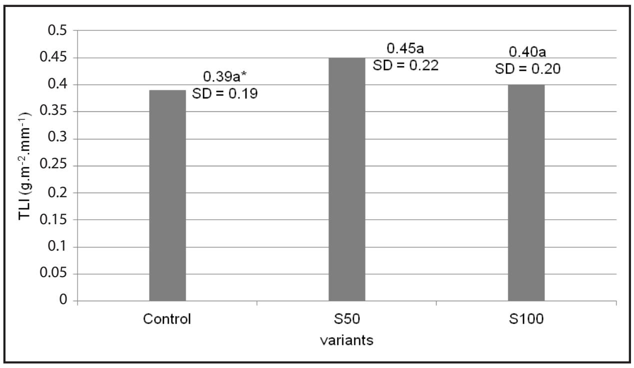

Figure 3 Thickening lawn index (*TLI*) (g.m^{-2}.mm^{-1}) in individual variants
Abbreviations see Figure 1

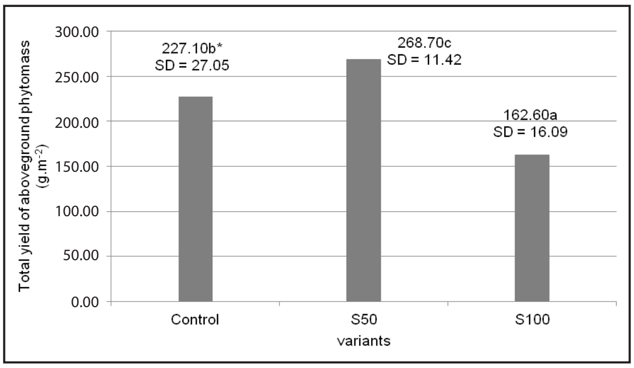

Figure 4 Total yield of dry above-ground phytomass (g.m^{-2}) in individual variants
Abbreviations see Figure 1

is "very low – low" production. Higher dose of Stockosorb (S100) was inhibitory and the total phytomass production of this variant was about 64.5 g.m^{-2} lower compared to the control ("very low" production).

4 Conclusions

Based on the results from this pot experiment we can noted that the daily intensity of growth and the total harvest of above-ground phytomass were statistically significant and intensity of phytomass production was non-significantly influenced by various doses of Stockosorb. Stimulatory effect on evaluated features showed only a dose of 50 g.m^{-2}. Application of 100 g.m^{-2} Stockosorb inhibited the growth-production process of *Festuca arundinacea* Schreb. cv. Koreta, but with lower variability values of some parameters (*ADGh*, *ADGw*, *TLI*). To future, the effects of application of hydroabsorbents should be investigated on the quality of turfs growed in natural conditions in context to global climatic changes.

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