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THE INFLUENCE OF CUT *Festuca rubra* L. TURF NOT REMOVED FROM THE LAWN SURFACE ON THE PROPORTION OF DICOTYLEDONS IN THE LAWN

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Abstract

The aim of the study was to assess how the proportion of dicotyledons in the lawn was influenced by aboveground biomass containing *Festuca rubra*, cv. 'Areta', 'Nimba', and 'Olivia', cut and left on the lawn surface. This influence was evaluated based on the changes in the species composition of the lawn sward. In the control treatments, the cut turf was removed from the lawn surface immediately after cutting.

The study showed that the botanical composition of the lawn varied and depended on the cultivar of *F. rubra* and the assessment date. In the treatments where the cut turf with *F. rubra* 'Areta' and 'Olivia' was not removed, grasses were found to have a higher proportion than dicotyledons and other unsown species, both in the spring and autumn. In the treatments with 'Nimba', this effect was only observed in the autumn. 'Nimba' demonstrated the greatest ability to limit the proportion of dicotyledons in the lawn sward.

Key words: cut turf, proportion of dicotyledons, botanical composition of sward

INTRODUCTION

The continuing chemicalisation of agriculture poses a significant threat to the natural environment and has led to intensified research into the possibility of using allelopathic effects to biologically control weeds as well as using allelochemicals as natural pesticides or models for the production of new environmentally friendly alleloherbicides (Bhowmik and Inderjit, 2003; Macias et al. 2001). There is a range of data showing the allelopathic potential of various plant species that can be used to suppress weed growth (Bhowmik and Inderjit, 2003; Duke et al. 2001; Macias et al. 2001). The knowledge of the allelopathic activity of species and cultivars in the meadow/pasture and lawn grass communities also offers good prospects for using allelopathy to increase biodiversity and to control weeds. Experiments conducted on species such as *Cirsium, Carduus, Silybum* and *Onopordum* confirm that grasses exhibit an inhibitory effect on seed germination and viability of weeds (Beyschlag et al., 1996; Bourdot et al. 1996). Research by Bourdot et al. (1996) shows that *Lolium perenne, Holcus lanatus* and *Phalaris aquatica* are particularly effective inhibitors of *Cirsium.* The water extracts from *Holcus lanatus, Hypochoeris radicata* and *Trifolium repens* systematically inhibited the growth of *Plantago lanceolata* and *Rumex acetosa*, among other species (Harborne, 1997), while the residue of *Dactylis glomerata, Bromus wildenowii, Festuca arundinacea, Lolium perenne, Holcus lanatus* and *Phalaris aquatica* strongly inhibited the emergence as well as root and shoot elongation of *Carduus nutans* (Wardle et al. 1996). The allelopathic effect of *Lolium perenne* and *Festuca rubra* on many weeds has been confirmed by many authors (Kawate and Appleby, 1986; Takahashi et al. 1988; Beyschlaga et al. 1996). It is believed that the allelopathic influence of *Medicago sativa* on certain weed species may play a significant role in the study of herbicides used in the growing of *Medicago sativa* (Miller, 1996). The capacity of specific grasses to displace weeds from pasture land was also observed in Taiwan (Chou, 1986). This phenomenon is usually explained by the high competitiveness of grasses resulting from the high density of sward, but allelopathic effects are also possible reasons. It was assumed in this study that substances washed out from *F. rubra* leaves by rain or dew drops, or released in the decomposition

of the cut tiny fragments of leaf blades, can have allelopathic potential and thus influence the proportion of dicotyledons in the lawn sward.

Therefore, the aim of the study was to assess how the proportion of dicotyledons in the lawn was influenced by aboveground biomass containing *Festuca rubra*, cv. 'Areta', 'Nimba', and 'Olivia', cut and left on the lawn surface.

MATERIALS AND METHODS

The investigation was conducted in field conditions at the Teaching and Research Station in Sosnowica (University of Life Sciences in Lublin, Department of Grassland and Landscape Forming) in the years 2008 to 2010. An experiment with monocultures of lawn cultivars of *F. rubra* was established in 2003. The allelopathic potential of three *F. rubra* cultivars, i.e. 'Areta', 'Nimba' and 'Olivia', was assessed based on the changes in the species composition of the lawn and the proportion of dicotyledons in the lawn under conditions of exposure to the aboveground biomass that was cut in the growing season and left on the lawn surface (treatment A), and under control conditions where the cut turf was removed from the lawn immediately after cutting (treatment B).

Two equal doses of mineral fertiliser, i.e. N- 60; P- 20; K- 40 kg ha^{-1}, were used in all the treatments under study in the growing season. The first dose was applied in late April/early May, and the second one in the first 10 days of August. The sward was cut 10 times to a length of 5 cm. These measures were performed in accordance with COBORU (Polish Research Centre for Cultivar Testing) recommendations for Park-type mixtures.

In order to determine the changes in the species composition, including the proportion of dicotyledons in the sward, plant samples were collected from the treatments (from an area of 0.08 m^2, four replications) in the spring (April) and autumn (October) each year. The samples were then dried and subjected to a botanical gravimetric analysis. Data concerning the proportion of dicotyledons in the sward were analysed statistically by means of analysis of variance. Tukey's confidence intervals ($p \leq 0.05$) were used to verify which means were significantly different from one another.

RESULTS

The botanical analyses of the sward with *F. rubra* 'Areta' performed in the spring showed *F. rubra* had a predominant share in treatments A where the cut turf was left on the lawn surface, while the proportion of dicotyledons was small. At the same time, a much smaller proportion of *F. rubra* 'Areta', an increased proportion of weeds and the presence of other unsown grasses were observed in treatments B where the aboveground biomass was removed from the surface immediately after cutting (Fig. 1). At the end of the growing season, the proportion of *F. rubra* in treatments A slightly decreased, while the proportion of dicotyledons remained at a similar level, in comparison with the spring. In the case of the control treatments (B), an increased proportion of *F. rubra* 'Areta' and weeds was observed in the lawn sward in comparison with the spring. However, the proportion of *F. rubra* was significantly smaller and the proportion of dicotyledons was higher compared to treatments A.

As for the species composition of the sward with *F. rubra* 'Nimba', it was found that at the beginning of the growing season (before cutting), the proportion of the initial component (*F. rubra* 'Nimba') in the sward was 51%, while dicotyledons accounted for 26% and other unsown grass species for 23% of the sward in treatments A where the cut biomass was left on the surface. The sward of the control treatments was dominated by *F. rubra* 'Nimba', with weeds accounting for about 17% and other unsown grass species representing a very small percentage of the sward species (Fig. 2). In the autumn (after the cutting was finished), the proportion of *F. rubra* 'Nimba' increased in treatments A and considerably decreased in the control treatments in comparison with the spring. By the same token, weeds and other grass species had a lower proportion in treatments A, and a higher proportion in treatments B in the autumn.

When comparing the species composition of the sward containing *F. rubra* 'Olivia', considerable differences were found between treatments A (with the grass cut and left on the lawn surface in the growing season) and the control treatments (Fig. 3). Both in the spring and autumn, the species composition of the sward in treatments A was dominated by *F. rubra*, while the proportion of dicotyledons was small, amounting to about 7% at the beginning of the growing season (spring) and about 10% after the cutting was finished (autumn). In the control treatments, on the other hand, the proportion of *F. rubra* 'Olivia' was 71% in the spring, but fell to 55% in the autumn. Opposite trends were observed for dicotyledons and other unsown grass species whose proportion increased by more than a half in comparison with the spring.

A statistical analysis of the study results revealed that the proportion of dicotyledons in the lawn was significantly influenced by the cut grass that was left on the lawn surface (during the growing season). Regardless of the variety, the percentage of dicotyledons was about 8% in treatments A where the cut grass was left on the lawn surface and as much as 25% in treatments B where the biomass was removed immediately after cutting (Fig. 4).

The effect of cut turf with *F. rubra* significantly depended on the cultivar. The lowest proportion of dicotyledons was observed in the lawn exposed to cut grass with the cultivar 'Nimba'; the highest proportion of dicotyledons was recorded for the cultivar 'Olivia' (Fig. 4).

The statistical analysis also showed significant differences both between the spring and autumn assessment dates as well as between treatments A and B with regard to the proportion of dicotyledons in the sward with the particular cultivars of *F. rubra* (Table 1). It is worth noting that dicotyledons had a smaller share in the lawn sward in spring than in autumn in the treatments with the cultivar 'Areta'. As for weeds, regardless of the assessment date, their proportion was significantly lower in treatments A where the cut grass was left than in treatments B from which the biomass was removed immediately after cutting. In treatments B, the proportion of weeds at the end of the growing season increased in comparison to spring. In the sward with *F. rubra* 'Nimba', the proportion of weeds in treatments A decreased from 25.2% in the spring to 7.7% at the end of the growing season, while in the control treatments their percentage increased significantly. Analysing the variation in the proportion of dicotyledons in the sward with *F. rubra* 'Olivia', it was found that weeds had a significantly lower proportion in treatments A than in the control treatments where a particularly large increase of dicotyledons was observed, from 19.6% in the spring to 30.6% at the end of the growing season in the autumn (Table 1).

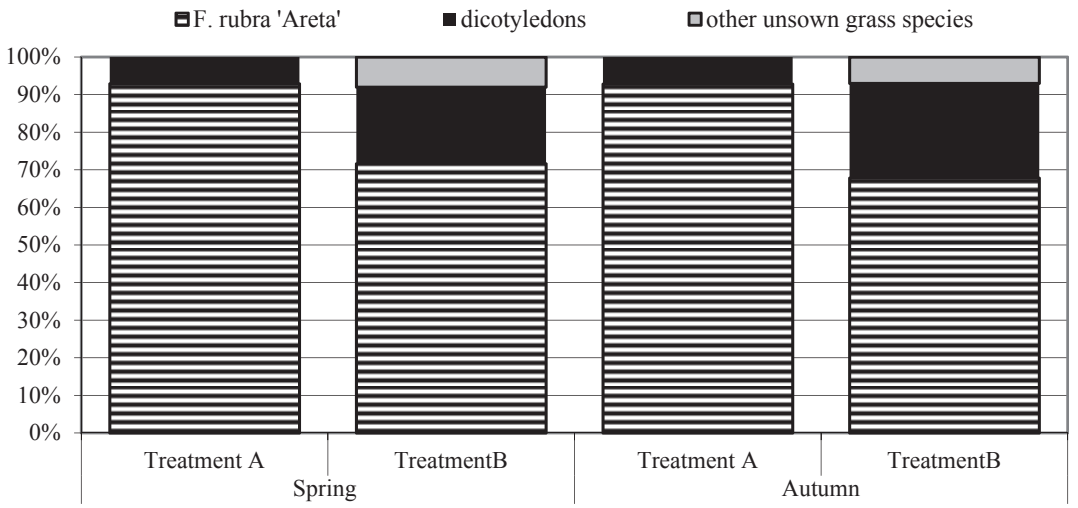

Fig. 1. The species composition of the lawn sward with *F. rubra* 'Areta' in treatments A with the cut turf left and in the control treatments (B) with the cut turf removed immediately after cutting.

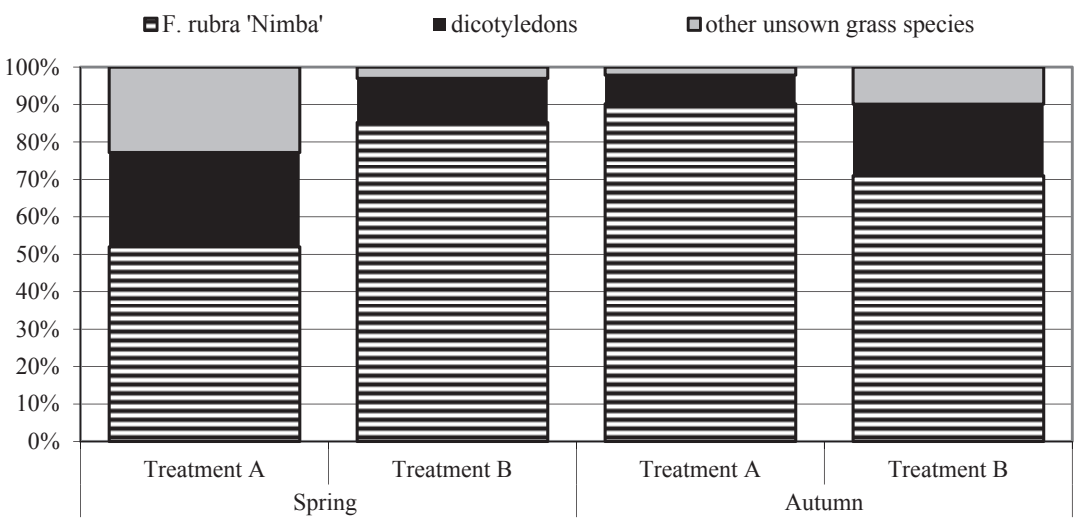

Fig. 2. The species composition of the lawn sward with *F. rubra* 'Nimba' in treatments A with the cut turf left and in the control treatments (B) with the cut turf removed immediately after cutting.

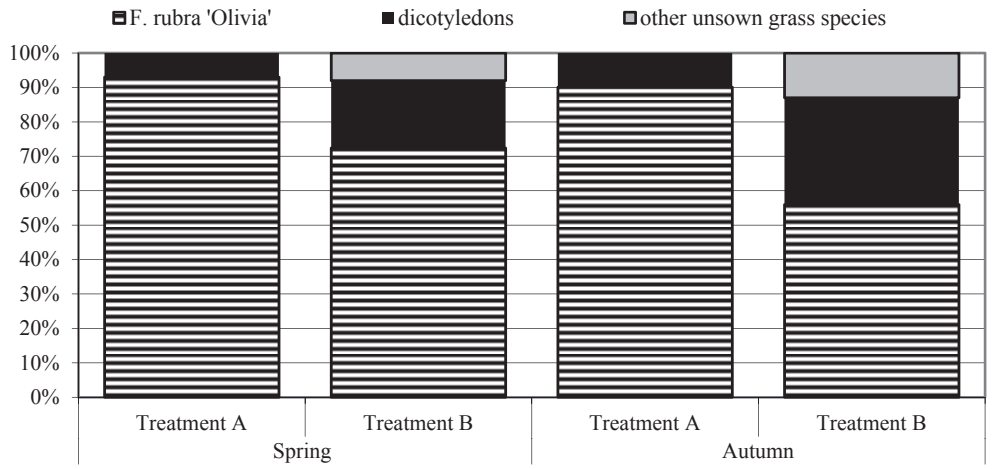

Fig. 3. The species composition of the lawn sward with *F. rubra* 'Olivia' in treatments A with the cut turf left and in the control treatments (B) with the cut turf removed immediately after cutting.

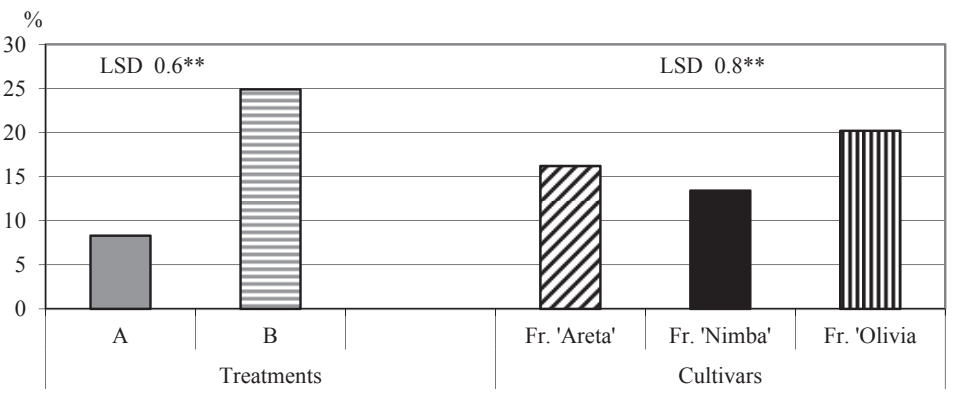

Fig. 4. The proportion of dicotyledons in the lawn sward with *F. rubra* depending on the treatment (A – the cut turf left on the lawn; B – the cut turf removed from the lawn immediately after cutting) and on the cultivar.

Table 1.

The proportion of dicotyledons in the lawn sward with *F. rubra* 'Areta', 'Nimba' and 'Olivia', depending on the treatment (A – the cut turf left on the lawn; B – the cut turf removed from the lawn immediately after cutting) and on the assessment date

Cultivar	Treatments	Assessment date		Mean for treatments
		Spring	Autumn	
'Areta'	A	7.1	7,2	7.1
	B	20.4	25.2	22.7
	Mean for the dates	13.7	16.2	
	LSD (p≤0.05) for:			
	treatments		0.6**	
	dates		0.6**	
	treatments x dates		1.2**	
'Nimba'	A	25.2	7.7	16.5
	B	11.8	19.1	15.4
	Mean for dates	18.5	13.4	
	LSD (p≤0.05) for:			
	treatments		0.8*	
	dates		0.8**	
	treatments x dates		1.6**	
'Olivia'	A	7.0	9.8	8.4
	B	19.6	30.6	25.1
	Mean for dates	13.3	20.2	
	LSD (p≤0.05) for:			
	treatments		0.8**	
	dates		0.8**	
	treatments x dates		1.6**	

DISCUSSION

Our study revealed that the turf with *F. rubra* that was cut and left on the lawn surface had a significant influence on the species composition of the sward. The possible allelopathic properties of *F. rubra* are indicated by the smaller number of dicotyledons and other unsown grasses in the treatments where the cut turf was left in comparison with the treatments where it was removed immediately after cutting. Extensive research towards using the allelopathic potential of *F. rubra* to control weeds, particularly on peat soils, was conducted by Bertin et al. (2003). Through field and laboratory experiments, Bertin et al. (2005) also demonstrated that the allelopathic potential of *F. rubra* (spp. *rubra, trichophylla, littoralis* and *commutata F. longifolia*) was related to the occurrence of m-tyrosine in their root exudates. In bioassays it was proved that *m*-tyrosine inhibits growth of *Digitaria sanguinalis*, *Trifolium repens* and *Taraxacum officinale*, among other species. According to the above authors, the allelopathic properties of *Festuca sp.* can be used to control weeds on various grass surfaces such as grass pitches, golf courses, and lawns. The allelopathic activity of *F. rubra* was also indicated in earlier research carried out by Falkowski (1958) who showed that seed germination of *P. pratensis* and *D. glomerata* was significantly poorer on water extracts from the soil where *F. rubra* was growing than on water extracts from the soil not covered by grass vegetation. Falkowski also pointed out the seasonal character of the accumulation of allelopathic substances in the soil. He showed that the amount of inhibitory allelopathic substances in the soil increased from spring to summer and then decreased from summer to autumn. Those observations were corroborated in this study as the effect of the cut turf varied depending on the assessment date. In the autumn, a smaller proportion of weeds was observed in the treatments where the cut turf was left on the lawn. Weston's field research (1997) also indicates poorer weed growth in the presence of the cut turf of *F. rubra*, particularly in the autumn.

Other, unpublished studies by Bertin and Sensac indicate considerable differences between lawn cultivars across *F. rubra* with regard to their ability to displace weeds. The studies discussed herein also reveal that the influence of cut *F. rubra* leaves not removed from the lawn depends on the cultivar of this species.

CONCLUSIONS

The present study showed that the species composition of the sward varied and depended on the cultivar of *F. rubra* and the assessment date. In the treatments where the cut turf of *F. rubra* 'Areta' and 'Olivia' was left, grasses were found to have a higher proportion than dicotyledons and other unsown species, both in the spring and autumn, whereas in the treatments where the cut turf of *F. rubra* 'Nimba' was left, grasses had a higher proportion only in the autumn.

A smaller proportion of dicotyledons and other species in the treatments with *F. rubra* sward not removed compared to the control treatments may indicate the allelopathic properties of this species.

The influence of the studied cultivars of *F. rubra* varied. The cultivar 'Nimba' demonstrated the greatest ability to decrease the proportion of dicotyledons in the lawn sward.

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Wpływ skoszonej murawy z *Festuca rubra* pozostawionej na powierzchni trawnika na udział w nim roślin dwuliściennych

Streszczenie

Celem badań była ocena wpływu skoszonej i pozostawionej na powierzchni trawnika biomasy nadziemnej z *Festuca rubra* 'Areta', 'Nimba' i 'Olivia' na udział w nim roślin dwuliściennych. Wpływ ten oceniano w oparciu o zmiany w składzie gatunkowym murawy trawnika. Kontrolę stanowiły obiekty, z których ściętą murawę trawnika usuwano z jego powierzchni bezpośrednio po skoszeniu.

Przeprowadzone badania wykazały, że skład botaniczny trawnika był zróżnicowany i zależał od odmiany *F. rubra* oraz terminu oceny. Na obiektach, gdzie pozostawiano ściętą murawę z *F. rubra* 'Areta' i 'Olivia' notowano, zarówno wiosną jak i jesienią, większy udział traw niż roślin dwuliściennych i innych niewysianych gatunków. Na obiektach z 'Nimba' efekt ten obserwowano tylko jesienią. Największe zdolności do ograniczania udziału roślin dwuliściennych w murawie trawnika wykazywała 'Nimba'.