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IMPACT OF ORGANIC FERTILISATION AND SUBSEQUENT GRASSLAND ABANDONMENT ON FLORISTIC COMPOSITION

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The aim of this study was to evaluate changes in floristic composition of permanent grasslands after the cessation of their regular utilisation and organic fertilisation. A long-term small plot trial was established in 2004 in locality Rapotín. During 2004–2012, the experiment was fertilised with compost and slurry, both with the range of stocking rates 0.9, 1.4 and 2.0 livestock units (LU)/ha (corresponding to 54, 84, and 120 kg N/ha). The plots were cut 2–4 times per year depending on given dose of fertiliser. During 2013–2016, the regular management was ceased and the grasslands were completely abandoned. Before the grassland abandonment, the highest total number of species (24 species) was found in the treatments regularly fertilised with compost. The dominance of grasses was influenced by the grassland management, with decreasing intensity of utilisation, the dominance of grasses increased. Four years after the grassland abandonment, the species diversity in almost all treatments decreased and the dominance of grasses increased in all treatments, up to the value 67–80%. Based on the data about the soil chemical parameters from two investigated years, our results suggested not only the effect of grassland management and its subsequent abandonment, but also a residual effect of the both organic fertilisers. These findings indicated the importance of the maintenance of regular grassland management for sustainable conservation of grassland communities.

Key words: floristic composition, organic fertilisation, utilisation, meadows, abandonment

Pastures and meadows are the permanent source of the forage for farm animals. Their floristic composition is based on the naturally occurring grasses and legumes and the farmer can improve or deteriorate them by his interventions. In a long term, the grassland composition can be influenced by the fertilisation and by the intensity of utilisation, i.e. number and dates of harvests.

For the support of the growth, the development and the proper quality of the fodder crops is essential for their adequate nutrition. In most of the enterprises that are engaged in plant and animal production, it is usual to fertilise grasslands with mineral fertilisers. Therefore, many authors investigated the influence of mineral fertilisation on the floristic composition of grasslands (e.g. Mrkvička & Veselá 2002; Hejcman *et al*. 2007; Smits *et al*. 2008; Britaňák *et al*. 2009; Hrevušová *et al.* 2009; Rotar *et al.* 2016). The systematic utilisation of farm manures in grasslands is not common because of their preferred application in the intensive crop management on arable land. Existing methodical recommendations for the utilisation of organic fertilisers often do not take into consideration many important criterions, such as the estimation of the type and the dose of fertiliser in relation to the type of grassland, the altitude, or the date of application. That is the reason why in the Czech Republic it is used to apply the long-time experience from the abroad, mainly from Austria (Hrabě & Buchgraber 2004).

The organic fertilisers are the irreplaceable base for the rational agriculture. The high-quality farm

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manures support the soil fertility and have other positive effects (Samuil *et al.* 2009). By their correct systematic application, the important nutrients are returned back to the soil and the additional fertilisation with mineral fertilisers is not generally necessary in grasslands. The difference is that the nutrients in inorganic fertilisers can be directly taken up by plants in contrast to nutrients in organic fertilisers, which have to be released by microbial metabolism to make most of them available to plants (Böhme *et al*. 2005).

The influence of organic fertilisers (cattle slurry, in particular) has been studied by, for example, Schellberg & Lock (2009), Liu *et al.* (2010), Lalor *et al.* (2011, 2012), Duffková *et al*. (2015), Angeringer *et al*. (2016). Duffková & Libichová (2013) assessed the effect of different application rates of cattle slurry on the plant species composition of three-cut grassland. These authors mentioned that application of cattle slurry up to 120 kg N/ha/year can be considered as suitable compromise between maintenance of species-rich grasslands and requirements of farmers for sufficient forage production. Estavillo *et al*. (1997) referred that the difference between cattle slurry and N fertiliser was that the slurry behaved as a slow-release fertiliser, its supply of mineral N being greater in the periods of time when fertiliser was applied a long time ago. As Khalid *et al*. (2013) documented, compost also works quite differently from synthetic fertilisers, as amending soil with compost provides a slow-release source of nutrients. Significant quantities of nutrients (particularly N, P, K and micronutrients) became bioavailable with time as compost decomposed in the soil.

There is an advantage of organic fertilisers, which lies in the fact that their application can positively influence the soil organic carbon content (Gonet & Debska 2006). Microorganisms, for example, bacteria, fungi, actinomycetes and microalgae, play a key role in organic matter decomposition, nutrient cycling and other chemical transformations in soil (Murphy *et al*. 2007). The results of Šimon & Czakó (2014) indicated that additions of organic matter from various sources differ in the effects on soil organic matter and biological activity. According these authors, long-term application of cattle slurry + straw was rather similar to mineral fertilisation. Hlisnikovský *et al*. (2016) came to the conclusion that the decomposition and subsequent stabilisation of fresh organic matter in time, the microbial interactions and mineralisation of soil organic matter (Gude *et al*. 2012) and changes of contents of organic carbon were probable reasons for the subsequent decrease of easily available carbon fractions and increase of available metals in their experiment. It follows that there should be a long-term residual effect of organic fertiliser application (Diacono & Montemurro 2010), which was, however, only rarely investigated in grasslands.

Another question, which has been frequently asked by scientists, is addressed to changes of grassland floristic composition after the total grassland abandonment (Bohner *et al.* 2006; Öckinger *et al*. 2006; Bohner & Starlinger 2011; Ronch *et al.* 2013; Plesa *et al.* 2014; Păcurar *et al*. 2015). The abandonment of semi-natural grasslands become a major threat and raises a series of questions and situations, which have to be solved in the whole of Europe (Osterburg *et al.* 2010). This topic is still timely, because the grassland abandonment is happening currently mainly in the less-favoured areas near the borders of the Czech Republic.

Our study is based on the long-term investigation of the small-plot trial with permanent grassland and it broadens the current knowledge about these topics. The aim of this paper was to investigate the impact of the long-term grassland management (different cutting intensity and different types and doses of organic fertilisers) and the subsequent grassland abandonment from the viewpoint of the species diversity and floristic composition.

MATERIAL AND METHODS

Study site

The monitoring of the influence of intensity of utilisation and type and level of grassland fertilisation with organic fertilisers on the dynamics in a phytocoenosis was initiated in Rapotín in 2004. The experimental site was situated in the Czech Republic (50°00´32´´N and 17°00´83´´E) at 390 m above sea level on the east slope position (declination between 5.1 and 6.2°) in a moderately warm region without temperature extremes (Quitt 1971). Average annual temperature is 7.2°C and annual precipitation 693 mm. Further meteorological data are given in Table 1. The soil was sandy-loam, *Haplic Cambisol* with horizons Am–Bv-Bv/Cc–Cc (classification system according to IUSS Working Group WRB 2006). Table 4 shows chemical soil properties determined in spring 2012 and 2016 according to the methods of Zbíral *et al*. (2002). The vegetation of the experimental area was classified as *Cynosurion* with some elements of *Arrhenatherion* (Moravec *et al.* 1995). Before the experiment set-up, the grassland was utilised as the pasture for cattle.

Treatments

A long-term small-plot experiment (plot size: 12.5 m^2) in completely randomised blocks with four replicates was investigated on permanent grassland. Two types of organic fertilisers were applied during 2004–2012: (S) cattle slurry, and (C) compost. Organic fertilisers were used in annual doses of nitrogen: 54 kg/ha, 84 kg/ha and 120 kg/ha, which approximately corresponded to 0.9 LU/ha (LU = livestock unit), 1.4 LU/ha and 2.0 LU/ha. Average concentrations of elements in organic fertilisers are mentioned in Table 2. The first half of the doses of the cattle slurry (diluted with water in a ratio 1:3) as well as the compost was applied early in spring and the second one after the first cut. The fertilisers were analysed for the content of nutrients before their application, which was conducted annually during 2004–2012. The plots were cut two to four times per year depending on the given dose of fertiliser. Treatments of the fertilisation and the cutting regime are given in Table 3.

During 2013–2016, the regular management ceased and the grasslands were completely abandoned for this time.

Experimental measurements

The floristic composition was determined in spring (during 2004–2012 and in 2016) by means of the method of reduced projective dominance according Veselá *et al*. (2002). The projective dominance (*D*) of all vascular plant species was visually

T a b l e 1

Long-term annual average [1961–1990] in temperatures and precipitations in the locality of Rapotín

	Normal
Average temperature during the vegetation season [°C]	9.1
Average annual temperature [°C]	7.2
Average precipitation during the vegetation season [mm]	481
Average annual precipitation [mm]	693

T a b l e 2

Soil chemical properties determined in spring 2012 and 2016

Treatment	pH (0.01 $CaCl_2$)		C_{ox} [%]		N_{tot} [%]		Ratio C/N		P [mg/kg]		K [mg/kg]		Ca [mg/kg]		Mg [mg/kg]	
	2012	2016	2012	2016	2012	2016	2012	2016	2012	2016	2012	2016	2012	2016	2012	2016
S-0.9	4.83	5.10	1.59	0.88	0.19	0.20	8.44	4.32	59	46	186	150	2078	2118	204	269
S-1.4	4.70	5.18	1.44	0.85	0.17	0.20	8.52	4.21	55	61	155	124	1954	2125	185	291
S-2.0	4.78	5.17	1.41	0.93	0.17	0.19	8.13	4.85	65	57	162	107	1855	2107	195	296
C-0.9	5.13	5.43	1.58	1.20	0.20	0.24	8.10	5.06	85	75	196	138	2399	1760	228	279
C-1.4	5.06	5.12	1.61	1.13	0.19	0.22	8.39	5.13	71	64	151	114	2384	2823	213	321
C-2.0	5.21	5.52	1.74	1.17	0.19	0.22	9.13	5.22	92	93	180	127	2493	2742	247	323

Treatment – see Table 3; C_{ox} – oxidizable organic carbon; N_{tot} – total nitrogen in soil estimated directly in the percentages in each plot and each year of the study. The reduced projective dominance method was used, consequently, the sum of abundances for all plant species was 100%. Plant species were determined based on the descriptions of the vascular plants in the national flora (Kubát *et al*. 2002).

Species diversity was measured as the total number of species (richness) recorded in particular treatments, and it was further expressed in form of the Simpson´s diversity index (Begon *et al*. 1997) modified according Klimeš (2000):

$$DI = \frac{1}{\sum_{i=1}^{s} p_i^2}$$

where: p_i is the projective dominance of *i*-species and *S* is total number of species (richness).

Data analysis

Redundancy analysis (RDA) was used to investigate the relationships between floristic composition and applied management. Centering and standardisation by species was used in all analyses. The statistical significance of the first and all other constrained canonical axes was determined by the Monte Carlo permutation test within each block (499 permutations). All ordination analyses were performed in the CANOCO program (ter Braak & Šmilauer 2002). An ordination diagram was created in CanoDraw for Windows 4.14 for graphically visualising the results.

RESULTS

Species diversity

The amount of plants species presented in 2012 (before grasslands abandonment) and 2016 (after four years of grasslands abandonment) are shown in Table 4. From these results, it is evident that the highest total number of species (24 and 23 species) was found in the treatments regularly fertilised for 9 years with compost (by all types of intensities of utilisation) in 2012. It was due to the presence of rare plant species (dominance < 1%). On the contrary, treatments fertilised 9 years with slurry were characterised by the lower total number of species (15–19 species) in 2012. There is also obvious the

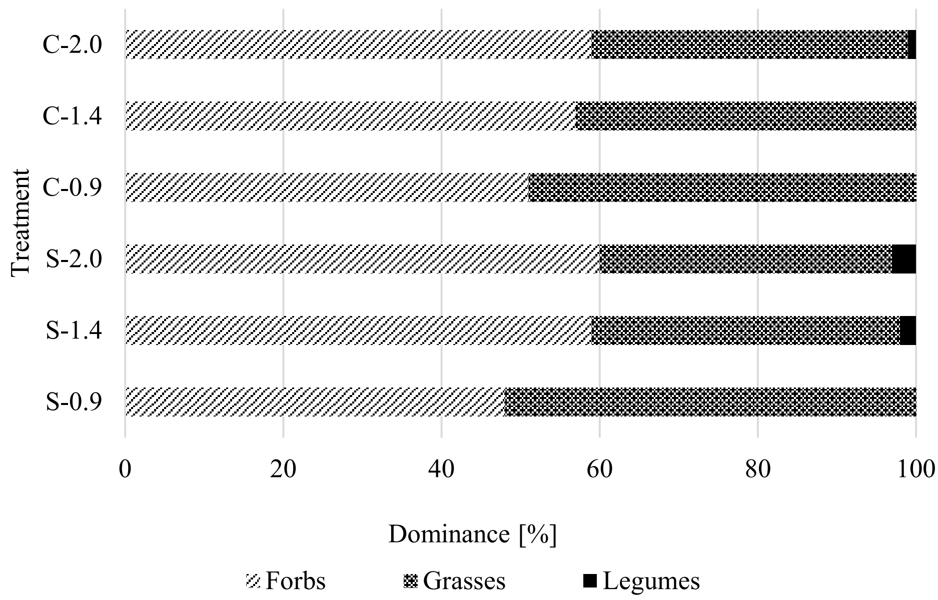
Table 3

Description of treatments with different grassland management (before abandonment)

Treatment	Fertilisation	Annual dose of nitrogen	Application	1st cut	2nd cut	3rd cut	4th cut
S-0.9	cattle slurry (diluted with water 1:3)	54 kg/ha	50% of dose – in spring, 50% of dose – after the 1st cut	June 15	Sept. 30	–	–
S-1.4	cattle slurry (diluted with water 1:3)	84 kg/ha	50% of dose – in spring, 50% of dose – after the 1st cut	May 30	July 30	Sept. 30	–
S-2.0	cattle slurry (diluted with water 1:3)	120 kg/ha	50% of dose – in spring, 50% of dose – after the 1st cut	May 15	June 30	Aug. 15	Sept. 15
C-0.9	compost	54 kg/ha	50% of dose – in spring, 50% of dose – after the 1st cut	June 15	Sept. 30	–	–
C-1.4	compost	84 kg/ha	50% of dose – in spring, 50% of dose – after the 1st cut	May 30	July 30	Sept. 30	–
C-2.0	compost	120 kg/ha	50% of dose – in spring, 50% of dose – after the 1st cut	May 15	June 30	Aug. 15	Sept. 15

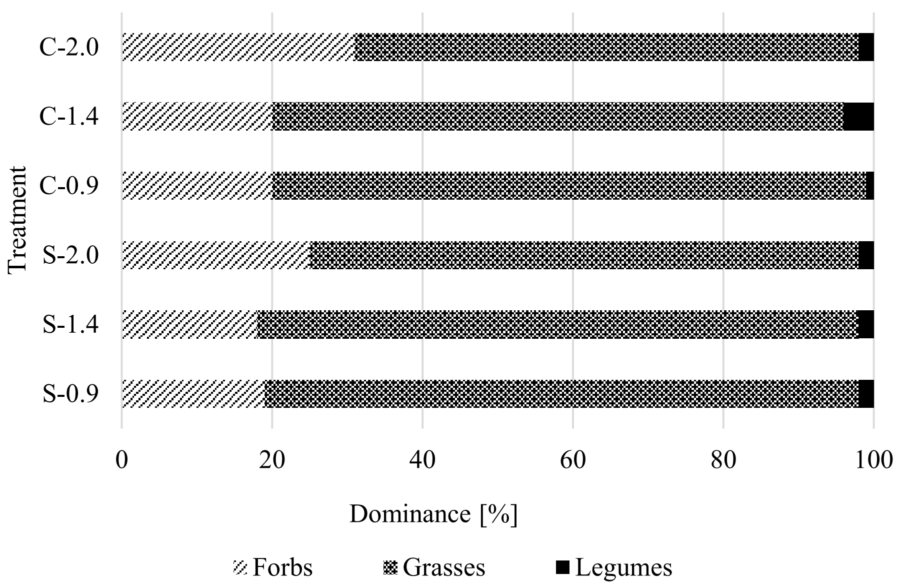
influence of the intensity of utilisation in the treatments fertilised with slurry in 2012 – with decreasing intensity of utilisation (by the simultaneous decreasing doses of the fertiliser) the total number of species decreased. The values of the Simpson´s diversity index (Table 4) indicated that the grassland fertilised with slurry were distinguished by the higher species diversity in terms of the equitability of the plant community (DI = 7.56–8.54) than the grassland fertilised with compost (DI = 5.59–6.22).

Four years after the grasslands abandonment, the total number of species in all treatments, but one



Treatment – see Table 3

Figure 1. The dominance of functional groups in grasslands in 2012



Treatment – see Table 3

Figure 2. The dominance of functional groups in grasslands in 2016

(S-0.9), decreased. The most important changes in terms of the number of species were found in the treatments previously fertilised with compost. In case of the treatment fertilised with compost by the simultaneous extensive grassland utilisation (two cuts per year), the total number of species decreased from 23 species up to the minimal level of 13 species, whereas mainly the species with dominance < 1% disappeared from the grasslands. The Simpson´s diversity index decreased in all treatments, mainly in treatments formerly fertilised with slurry, which indicated the unbalanced communities in terms of their floristic composition. Overall, the differences in the species diversity among treatments decreased during four years of abandonment, which is apparent both on the values of the Simpson´s diversity index and on the values of the species richness.

Evaluation of the dominance of plant species and functional groups

Table 5 shows more detailed data about the dominance (in %) of particular species and functional groups (grasses, legumes and forbs) in 2012 and 2016. There were found differences between treatments in the dominances (% *D*) of functional groups in 2012 (Figure 1) and 2016 (Figure 2). In 2012, the dominance of grasses was influenced by the management, with decreasing intensity of utilisation (by simultaneous decreasing doses of fertilisers), the dominance of grasses increased. The dominance of legumes was the highest (*D* = 3%) by the most intensive grassland utilisation (four cuts per year) by simultaneous highest dose of slurry (2.0 LU/ha). The extensive grassland utilisation (by the fertilisation with both slurry and compost) had the negative effect on the dominance of legumes in the swards.

Four years after the regular management cessation, the differences between the two treatments decreased and the grasslands became to show the similar floristic composition in terms of the dominance of particular functional groups. From the Figure 2, it is obvious that the dominance of grasses increased in all treatments, up to the value 67–80%. It was mainly due to increasing the dominance of *Dactylis glomerata* L. and *Bromus hordeaceus* L., both plant species are the tall grasses with the high competitive ability. Occurrence of legumes was stabilised at the level of 2%.

The mentioned results about the floristic composition were statistically evaluated in more detail by means of the redundancy analysis (RDA). The ordination diagram RDA (Figure 3) shows the explanatory variables (management and year) and the dependent variables (dominance of a plant species in %). RDA explained 35.4% of the total variability, whereas the first two canonical axes get a share of 26.8%. The first canonical axis (which closely fits with the centroids of the variable ‘year’) explained 19.2% of the total variability. The second axis (which closely fits the variable ‘management’) explained 7.6% of the total variability. This ordina-

T a b l e 4

The values of species diversity in particular treatments in 2012 and 2016

Treatment	Simpson´s diversity index (DI)		Number of species with D > 1%		Number of species with D < 1%		Total number of species (S)	
	2012	2016	2012	2016	2012	2016	2012	2016
S-0.9	7.56	4.67	13	13	2	3	15	16
S-1.4	8.54	4.98	15	12	3	3	18	15
S-2.0	8.36	5.17	17	12	2	2	19	14
C-0.9	5.68	5.12	12	10	11	3	23	13
C-1.4	5.59	5.43	11	12	13	2	24	14
C-2.0	6.22	6.07	12	12	12	3	24	15

Treatment – see Table 3

tion was found statistically significant (F = 3.288, p = 0.002).

Moreover, from the Figure 3, it is apparent that in 2012 (last year of the different managements), there was characteristic the higher occurrence of some forb species (e.g. *Taraxacum* sect. *Ruderalia, Cerastium holosteoides* Fr., *Veronica arvensis* L.) in the swards. On the contrary, in 2016 (four years after the abandonment), some tall grasses (e.g. *Bromus hordeaceus* L.), which were probably suppressed by the previous management, newly occurred. There is also information on which species positively responded to the long-term regular fertilisation with slurry (e.g. *Dactylis glomerata* L., *Stellaria graminea* L., *Rumex obtusifolius* L.), or to the fertilisation with compost (e.g. *Achillea millefolium* L., *Poa pratensis* L., *Geranium pyrenaicum* Burm. F.).

Table 2 shows differences in the content of soil nutrients between years and treatments, whereas mainly the ratio C/N changed during years. These changes can be attributed to microorganisms, e. g. bacteria, fungi, actinomycetes and microalgae, which play a key role in organic matter decomposition, nutrient cycling and other chemical transformations in soil.

DISCUSSION

Influence of the grassland management on the vegetation is not always definite and the results between authors can vary. The differences could be caused by different site conditions and research

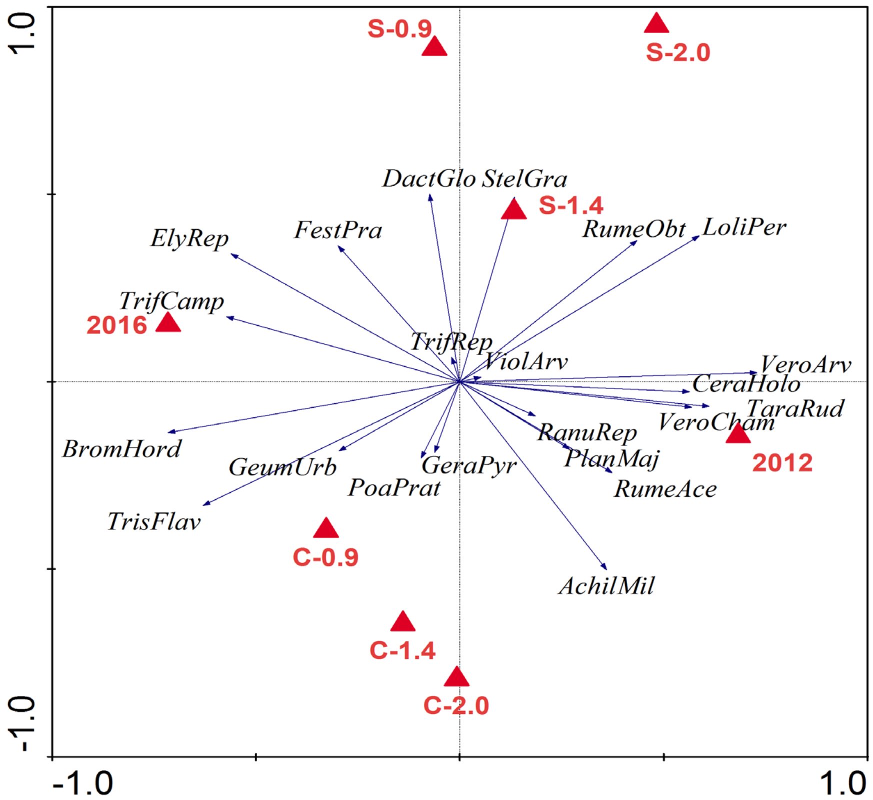


Figure 3. Ordination diagram showing differences between treatments in the dominance of particular species in 2012 and 2016

Note:
FORBS: *AchilMil* = *Achillea millefolium; CeraHolo* = *Cerastium holosteoides; GeraPyr* = *Geranium pyrenaicum; GeumUrb* = *Geum urbanum; PlanMaj* = *Plantago major; RanuRep* = *Ranunculus repens; RumeAce* = *Rumex acetosa; RumeObt* = *Rumex obtusifolius; StelGra* = *Stellaria graminea; TaraRud* = *Taraxacum* sect. *Ruderalia; VeroArv* = *Veronica arvensis; VeroCham* = *Veronica chamaedrys; ViolArv* = *Viola arvensis;* GRASSES: *BromHord* = *Bromus hordeaceus; DactGlo* = *Dactylis glomerata; ElyRep* = *Elymus repens; FestPra* = *Festuca pratensis; LoliPer* = *Lolium perenne; PoaPrat* = *Poa pratensis; TrisFlav* = *Trisetum flavescens;* LEGUMES: *TrifCamp* = *Trifolium campestre; TrifRep* = *Trifolium repens*

methods. Our findings are in line with Ziliotto *et al.* (2002), who also mentioned that by the decreasing frequency of cuts there dominated tall grasses with the high competitive ability such as *Festuca arundinacea* Schreb. or *Dactylis glomerata* L. in the swards. Angeringer *et al.* (2016) recorded after three years of different management regime significant changes in coverage of the most frequent meadow species due to cutting regime, but few responses to the type of organic fertiliser. In spite of that, many other authors reported that the supply of nitrogen in fertilisers (either mineral or organic), as the part of the grassland intensification management, reduced the structural and floristic diversity of the sward

Table 5

Floristic composition (the dominances of particular species in percentages) of the grasslands in 2012 and 2016

Latin name	S-0.9		S-1.4		S-2.0		C-0.9		C-1.4		C-2.0	
	2012	2016	2012	2016	2012	2016	2012	2016	2012	2016	2012	2016
Achillea millefolium L.	11	6	5	3	12	6	23	9	25	5	21	12
Capsella bursa-pastoris (L.) Medik.	1	1	3	–	3	–	–	–	–	–	–	–
Cerastium holosteoides Fr.	4	1	7	2	6	2	1	1	7	2	5	2
Crepis biennis L.	–	–	–	–	–	–	1	–	–	–	–	–
Geranium pyrenaicum Burm. F.	–	–	1	–	1	–	–	–	–	1	1	1
Geum urbanum L.	–	–	–	–	–	–	–	–	–	–	–	1
Plantago lanceolata L.	3	–	–	–	1	1	2	1	1	1	2	–
Ranunculus repens L.	–	–	1	1	–	1	1	–	–	–	2	–
Rumex acetosa L.	–	–	1	–	–	–	–	–	1	–	1	–
Rumex obtusifolius L.	1	–	–	–	2	–	–	–	–	–	–	–
Stellaria graminea L.	3	4	1	3	3	5	1	1	–	–	2	–
Taraxacum sect. *Ruderalia*	14	5	23	6	21	7	14	7	13	10	15	10
Urtica dioica L.	–	–	–	–	1	–	–	–	–	–	–	4
Veronica arvensis L.	3	–	3	–	2	–	–	–	1	–	3	–
Veronica chamaedrys L.	5	2	9	3	5	3	8	1	9	1	4	1
Veronica serpyllifolia L.	3	–	5	–	3	–	–	–	–	–	3	–
Forbs in total	48	19	59	18	60	25	51	20	57	20	59	31
Alopecurus pratensis L.	1	–	–	–	–	–	–	–	–	–	–	–
Arrhenatherum elatius L.	–	–	–	–	1	–	–	–	–	–	–	–
Bromus hordeaceus L.	–	9	–	8	–	9	–	19	–	25	–	24
Dactylis glomerata L.	28	41	16	37	12	38	21	18	24	8	17	6
Echinochloa crus-galli (L.) P. Beauv.	–	–	1	–	–	–	–	–	–	–	–	–
Elymus repens (L.) Gould	5	5	4	4	3	5	4	7	1	5	1	4
Festuca pratensis Huds.	2	10	2	11	4	5	3	3	1	1	2	4
Lolium perenne L.	1	–	2	–	5	–	–	–	–	–	–	–
Phleum pratense L.	–	–	–	–	–	–	1	–	–	–	–	–
Poa pratensis L.	15	12	14	20	11	15	14	13	15	19	20	14
Trisetum flavescens (L.) P. Beauv.	–	2	–	–	1	1	6	19	2	18	–	15
Grasses in total	52	79	39	80	37	73	49	79	43	76	40	67
Trifolium campestre Schreb.	–	1	–	1	–	–	–	–	–	2	–	–
Trifolium repens L.	–	1	2	1	3	2	–	1	–	2	1	2
Legumes in total	0	2	2	2	3	2	0	1	0	4	1	2

Treatment – see Table 3

(Mrkvička & Veselá 2002; Rotar *et al*. 2006; Silva *et al.* 2008; Britaňák *et al.* 2009; Păcurar *et al.* 2011). Besides nitrogen, soil phosphorus content, in particular, is an important variable leading to a significant negative effect on species richness as documented by Hejcman *et al.* (2007, 2010), Helsen *et al.* (2014) or Riesch *et al*. (2016). These findings emphasised the importance of a reduction of nutrients for sustainable conservation of grassland communities.

The total grassland abandonment had a negative influence on the species diversity, which was demonstrated not only in our study, but this finding was also documented in studies of, for example, Isselstein *et al*. (2005) or Prévosto *et al.* (2011). Öckinger *et al*. (2006) referred that, when semi-natural pastures are abandoned, specialised grassland species are lost as a consequence of succession. There is no generally valid theory, which would describe changes in plant communities after the grassland abandonment. It is, in fact, the long-term process characteristic for each locality (Kahmen & Poschlod 2004; Pavlů *et al.* 2013). Nevertheless, many studies are in agreement that tall grasses with the high competitive ability and also the trees invade into the abandoned grasslands, thus, less light reaches the lower vegetation layers. The light is the basic requirement for the growth and the survival of many short plant species, so they are suppressed and the species diversity declines in the abandoned grasslands (Willems 1983). The site-climatic conditions, accumulation of the senescent material and of the nutrients play some role, as well. In such conditions, it is higher competitive ability of grasses than of forbs, which was also manifested in our experiment.

Results of Bohner & Starlinger (2011) show that the long-term effects of abandonment on grassland vegetation depend largely on local site conditions, and nutrient availability in the soil. Thus, in our study, the changes in floristic composition could be explained both by the effect of grassland abandonment and by the residual effect of application of organic fertilisers as data about the chemical soil properties indicated. Diacono & Montemurro (2010) mentioned that repeated long-term applications of organic amendments not only generally increase the size of the soil organic N pool, but also cause remarkable changes in soil characteristics, which influence N dynamics and can lead to a residual effect. Habteselassie *et al*. (2006) found an 89% increase in total soil N content after 5 years when dairy-waste compost at 200 kg/ha N was applied. The increase in total soil N content (although only in a small amount) was found also in our study four years after the last application of fertilisers, which was the most apparent in the treatments fertilised with compost. This finding is in line with the results of Šimon and Czakó (2014), who referred that additions of organic matter from various sources can differ in the effects on soil organic matter and biological activity. Generally, the composts are slowly decomposed in the soil, the continuous release of nutrients can sustain the microbial biomass population for longer periods of time (Murphy *et al*. 2007).

CONCLUSIONS

Four years after the grassland abandonment (in 2016), the differences between treatments decreased and the grasslands became to show the similar floristic composition in terms of the species diversity, as well as the dominance of particular functional groups. The total number of species as well as the Simpson's diversity index in almost all treatments decreased. The most important changes in species richness were found in the treatments previously fertilised with compost. The dominance of grasses increased in all treatments, up to the value 67–80%. Primarily the dominance of *Dactylis glomerata* L. and *Bromus hordeaceus* L. increased. Occurrence of legumes stabilised about the level 2%.

Our results suggested not only the effect of the grassland abandonment but also the residual effect of both organic fertilisers. Our findings indicated the importance of the maintenance of regular grassland management for sustainable conservation of grassland communities. As for the fertilisation, it is always important to consider in advance if a locality or grassland is suitable for the fertilisation, as the residual effect (mainly of organic fertilisers) can manifest itself for a long time.

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