INFLUENCE OF ORGANIC FERTILISATION ON A PERMANENT GRASSLAND BIODIVERSITY AND FLORISTIC COMPOSITION

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Abstract

The aim of this research is to highlight the changes that appear in the vegetation cover of grassland fertilised with different doses of solid manure. The analysed parameters are the level of biodiversity and the floristic composition of the sward. The dominant species of the studied grassland are Festuca valesiaca, Filipendula vulgaris and Rosa gallica. The analysed grassland is located in Grădinari (Caraş-Severin County, Romania), and the data were collected during 2004-2009 period. There were used three fertilisation doses of manure (20 t/ha^{-1}, 40 t/ha^{-1} and 60 t/ha^{-1}). The method of vegetation analysis is linear quadrate point method (Daget and Poissonet, 1971). The quantifying of the biodiversity was done using species richness (S), Shannon index (H') and Simpson index (D). The results obtained showed an interesting evolution of the vegetation sward during the research period, this being reflected in the various evolution of the species from a year to another and depending by fertilisation.

Keywords: grassland, fertilisation, solid manure, biodiversity, floristic composition.

INTRODUCTION

In the past the farmers tend to consider the animal manure as a waste instead of fertiliser because of the low price of the mineral nitrogen fertilisers, but the NPK content of the manure isn't negligible (Peeters, 1997).

The substantial amounts of manure applied on grassland may influence the species composition. The organic inputs are associated with the importation of seeds with poor ecological and forager value (*Rumex sp.*) and the smothering of the sward by manure. Also, the effect of the sward covering by manure is similar with the screen created by litter accumulation (Plantureux *et al*., 2005).

After Farrugia *et al*. (2008) the higher fertilization inputs associated with grass cutting for hay has increased the plot homogeneity and reduced the vegetation diversity.

The results obtained by Bengtsson *et al.* (2005) suggest that the difference between organic and conventional farming is more pronounced in studies performed at a small scale that do not take the surrounding landscape into account. This is indicating that farming practice only partly explains the variation in species richness and the abundance in agricultural landscapes.

Hole *et al.* (2005) shows that despite the pressing need for long-term, system-level studies of the biodiversity response to organic management at the landscape scale, the available evidence indicates that organic farming could play a significant role in increasing biodiversity across lowland farmland in Europe.

The results obtained by Jeanneret *et al.* (2007) show that the biodiversity scores increased from the low intensive grasslands (fertilized with solid manure) to extensive grasslands.

MATERIAL AND METHOD

The researches were developed in permanent grassland from Grădinari (Caraş-Severin County) from 2004 to 2009.

The experimental plots were used three different doses of solid manure fertilisation, respectively 20 t ha^{-1}, 40 t ha^{-1} and 60 t ha^{-1}; thus it was used as control a non-fertilised variant. The experience has five replicates.

The vegetation data were collected using the linear quadrate point method considering the number of contacts (Daget *et* Poissonet, 1971). The data from the botanical surveys were used for the calculation of the specific contribution (SC%) using the following formula:

$$SC_i \% = (C_i / C) \times 100 \quad (1)$$

where:

C_i = number of contacts of the species i from a botanical survey;

C = the total number of contacts from a botanical survey (Jauffret *et al.*, 2004).

The biodiversity of the vegetation cover was calculated using the Shannon index H' and Simpson index (D). H' was calculated using the entropy formula:

$$H' = -\sum_{i=1}^{S} p_i \times \ln p_i \quad (2)$$

where:

S = species number from the studied sample (species richness);

p_i = proportion of the species i from S (Beals *et al.*, 2000).

D was calculated after the following formula:

$$D = \sum_{i=1}^{S} p_i^2 \quad (3)$$

where:

$p_i = n_i / N$

n_i = total number of i species individuals;

N = total number of individuals of those species from the sample (Beals *et al*., 1999).

The floristic composition of the sward was considered from the point of view of the main functional plant groups, respectively, grasses, legumes and other botanical families. The floristic composition was considered from different points of view: species richness, number of grasses, legumes and other species and the SC% of the plant groups mentioned before.

RESULTS AND DISCUSSION

Analysing the biodiversity (figure 1 a, b and c) from different points of view there have been obtained similar results both for *S, H'* and *D*. Thus, the greatest biodiversity was determined in 2008 in non-fertilised control variant. The lowest biodiversity was determined in 2004 in the plots fertilised with 40 t ha^{-1} solid manure. In the first year of fertilisation the greatest biodiversity was determined in the variant fertilised with 60 t ha^{-1} manure, but in the next year it has become the lowest.

The research developed by Jonason *et al.* (2011) show that the main effect of the organic farming on grassland from Sweden took place immediately after transition.

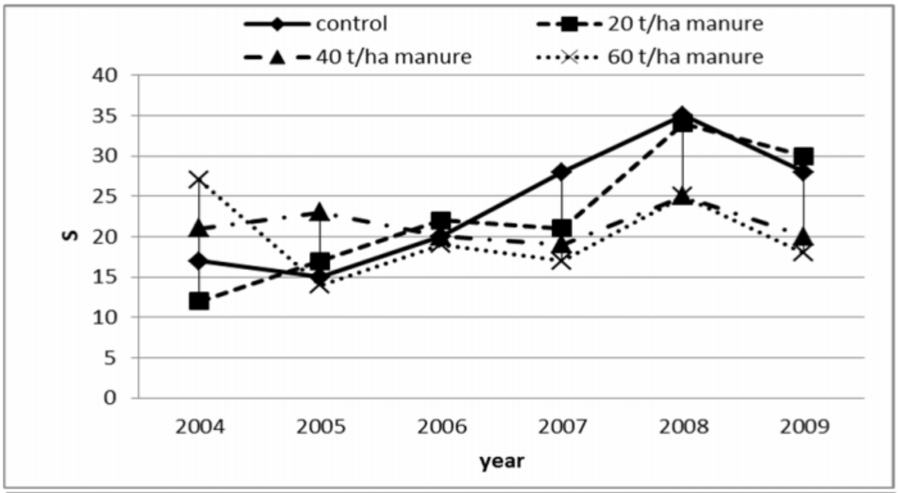
The results regarding the biodiversity show that the researches on grassland organic fertilisation need to be developed in long term experiences, because the immediate results aren't constant, they varying from a year to another.

Other aspect analysed in this research is the number of taxa on functional groups (figure 2 a, b, c), respectively grasses, legumes and other species. The greatest number of grasses was determined in the variant fertilised with 60 t ha^{-1} manure in 2004 at the first organic fertilisation, but in the following year it was the lowest. The grasses number hasn't show constant values for any variant. The number of legumes taxa was greatest in 2008 in the variant fertilised with 20 t ha^{-1} and 40 t ha^{-1} manure, and the lowest was in 2007 in the variant fertilised with 60 t ha^{-1} manure and in 2004 in the variant fertilised with 40 t ha^{-1} manure. An interesting evolution trend of the other species number of taxa was noticed in the case of the variant fertilised with 20 t ha^{-1} manure, which has registered the lowest number of taxa in 2004 and the highest in 2008 and 2009. A similar evolution was noticed in the non-fertilised variant.

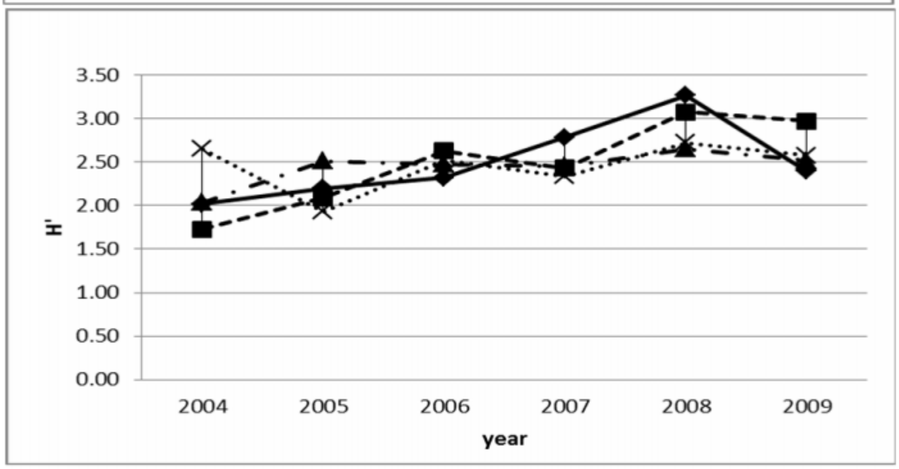
The SC% of the main functional groups is presented in figure 3 a, b and c. The greatest grasses SC% was determined in the variant fertilised with 40 t ha^{-1} manure in 2004 and the lowest in 2005 in the same variant. The greatest legumes SC% was in 2005 in the variants fertilised with 20 t ha^{-1} and 40 t ha^{-1} manure and the lowest in 2004 in at 40 t ha^{-1} manure. The greatest SC% of the other species was determined in 2006 at 60 t ha^{-1} manure, and the lowest in 2005 in the variant fertilised with 20 t ha^{-1} manure.

After Djukic *et al.* (2008) the manure applied on grassland determinates changes in the floristic composition involving a higher percentage of legumes in comparison with other species and grasses.

The floristic composition studies need long time researches, as in the case of biodiversity, to provide sustainable results.



a)



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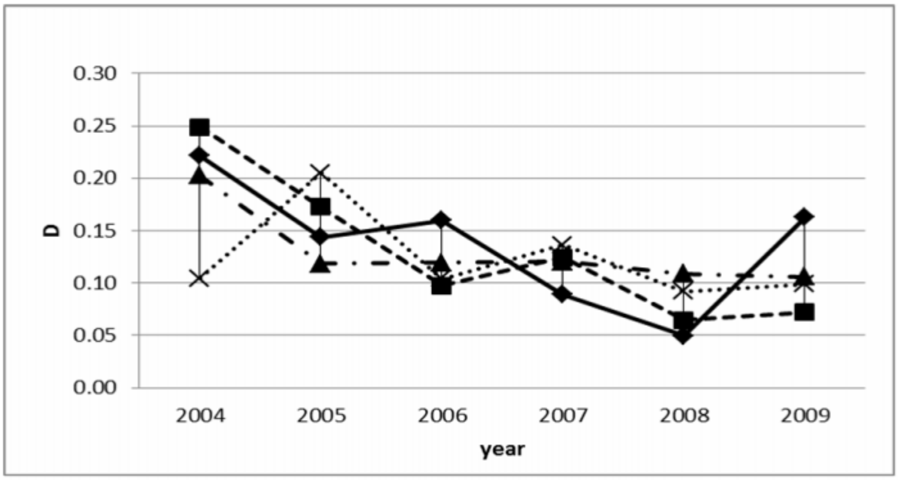
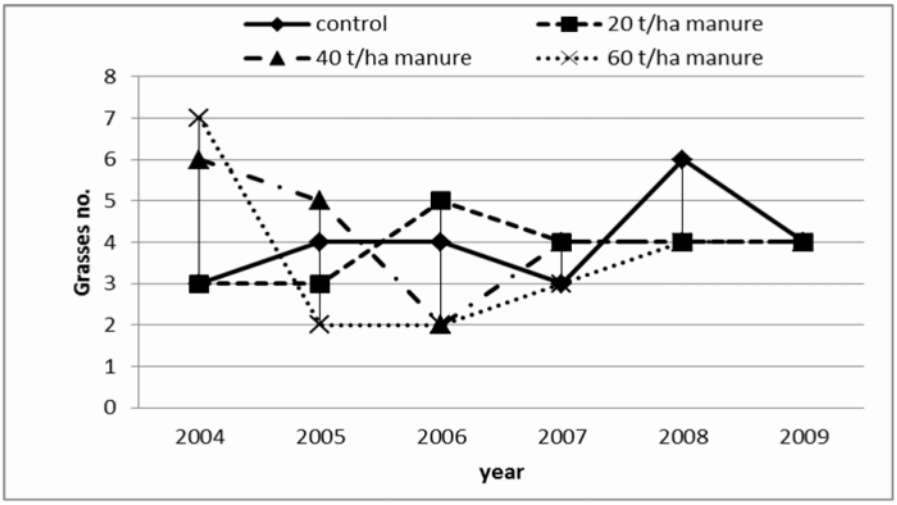


c)

Fig. 1. Biodiversity of the fertilised grassland plots in comparison with the control: a) species richness S; b) Shannon index (H'); c) Simpson index (D)



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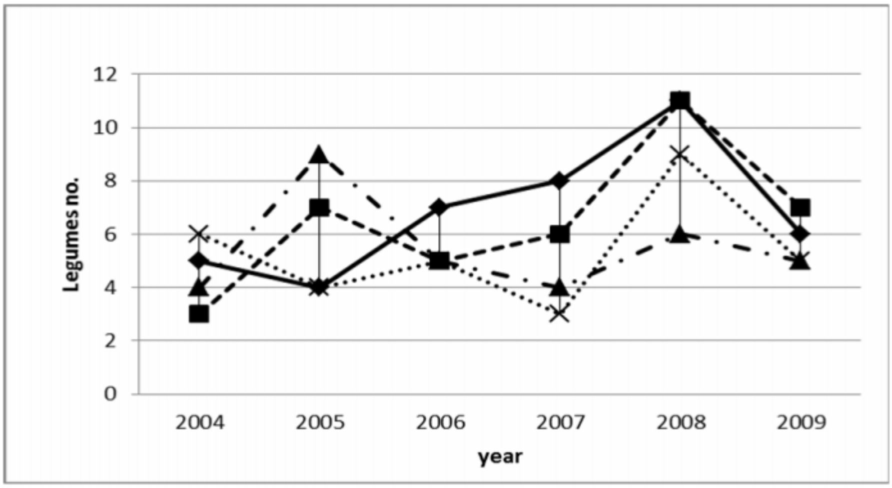

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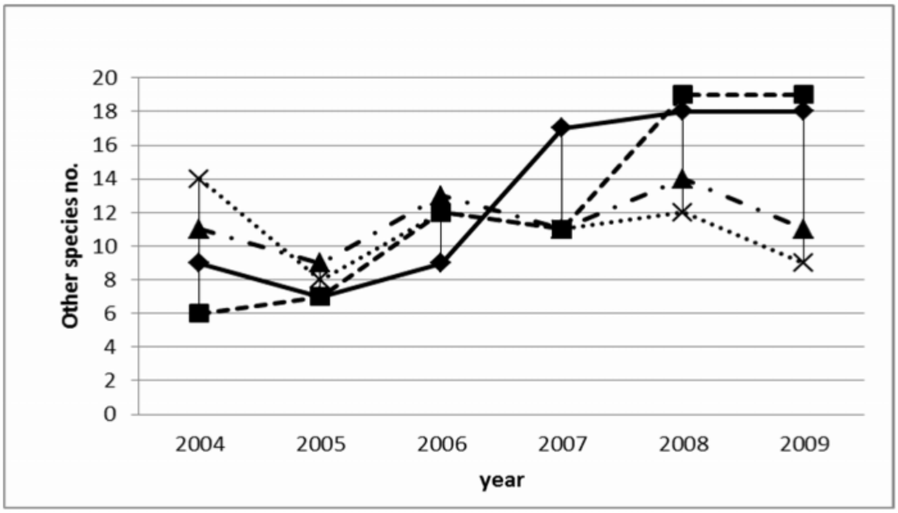

c)

Fig. 2. Number of taxa on functional groups: a) grasses; b) legumes; c) other species

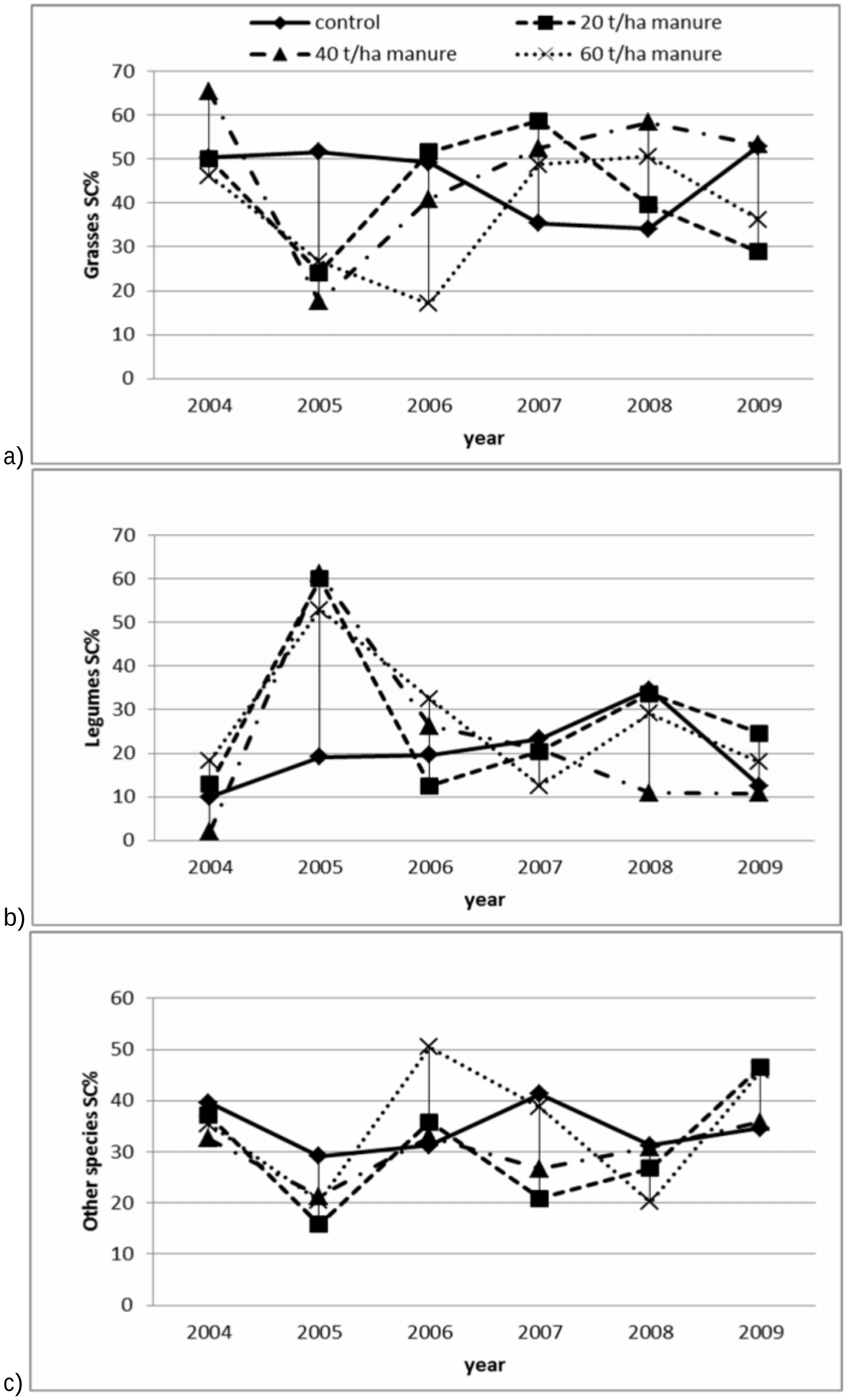

Fig. 3. Specific contribution (SC%) on functional groups: a) grasses; b) legumes; c) other species

CONCLUSIONS

The biodiversity results for the analysed variants were showing the absence of the fertilisation influence because the evolution trend was similar with the non-fertilised variant. The evolution of the number of taxa on the functional groups was inconstant in the case of grasses and legumes, while the other species have an ascendant trend in the case of the variant fertilised with 20 t ha^{-1} manure and non-fertilised variant. The SC% of the legumes has a spectacular increase in the second year of fertilisation, but in the following years studied it has decreased at values close to the control.

The researches on the organic fertilisation on grasslands is necessary to be realised in long time experiences because the data obtained in the first years of fertilisation can determinate the appearance of unsustainable data that can be very different from a year to another.

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REFERENCES

1. Beals, M., Gross, L., Harrell, S., (1999), Diversity indices: Simpson's D and E, http://www.tiem.utk.edu/~mbeals/simpsonDI.html, accessed at 12.12.2010.
2. Beals, M., Gross, L., Harrell, S., (2000), Diversity indices: Shannon's H and E, http://www.tiem.utk.edu/~mbeals/shannonDI.html, accessed at 12.12.2010.
3. Bengtsson, J., Ahnström, J., Weibull, A. – C., (2005), The effects of organic agriculture on biodiversity and abundance: a meta-analysis, Journal of Applied Ecology, 42: 261 – 269.
4. Daget, P., Poissonet, J., (1971), Une méthode d'analyse phytologique des prairies, Critéres d'application, Ann. Agron., 22(1): 5 – 41.

5. Djukic, D., Stevovic, V., Illic, O.,(2008), the effect of organic fertilizer on biomass yield and quality of natural meadows, Options Mediterraneennes, Series A., no. 79, p. 431 – 434.
6. Farrugia, A., Dumont, B., Jouven, M., Baumont, R., Loisseau, P., (2008), Specific and functional diversity of vegetation in three beef cattle farms of the French Massif Central, Grassland Science in Europe, 13: 96 – 98.
7. Hole, D.G., Perkins, A.J., Wilson, J.D., Alexander, I.H., Grice, P.V., Evans, A.D., (2005), Does organic farming benefit biodiversity?, Biological Conservation 122: 113–130.
8. Jauffret, S., Loireau, M., d'Herbès, J.M., Delanö,e, O., Long G., (2004), ROSELT/OSS CT14, 2004. Fiches techniques pour la construction dans ROSELT/OSS de quelques indicateurs écologiques et de la biodiversité végétale. Collection scientifique et technique ROSELT/OSS, Contribution Technique n°14, Montpellier, 63 p.
9. Jeanneret, Ph., Huguenin-Elie, O., Baumgartner, D., Freiermuth, Knuchel, R., Gaillard, G., Nemecek, Th., Weibel P., (2007), Estimation of grassland management impact on biodiversity, Grassland Science in Europe, 12: 382 – 385.
10. Jonason, D., Andersson, G. K. S., Öckinger, E., Rundlöf, M., Smith, H. G., Bengtsson, J., (2011), Assessing the effect of the time since transition to organic farming on plants and butterflies. Journal of Applied Ecology, 48: no. doi: 10.1111/j.1365-2664.2011.01989.x, accessed at 1.05.2011.
11. Peeters, A., (1997), Extensification of grasslands in Europe, Proceeding of the VIII International Grassland Congress, p. 281 – 288.
12. Plantureux, S., Peeters, A., McCracken, D., (2005), Biodiversity in intensive grasslands: Effect of management, improvement and challenges, Agronomy Research, 3 (2): 153-164.