THE ORGANIC-MINERAL FERTILIZATION OF A *FESTUCA RUBRA* L. GRASSLAND FOR EIGHT YEARS

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Abstract

The organic-mineral fertilization could be a realistic method of management of the grasslands while a strong decreasing of animals number takes place in Romania. On the grasslands in Apuseni Mountains, this type is not being practiced, but it could be a chance to maintain the oligotrophic grasslands in the mountainous landscape. The combined and long effect of organic and mineral fertilizers upon the dry matter is rather known, but the influence upon the phyto-diversity is less studied. This papers' objective is to survey the effect of organic and mineral fertilizers application upon the phyto-diversity of a meadow from the boreal floor. After an eight years period, the administration of mineral and organic fertilizers produces important changes at herbaceous canopy level, two floristic structures being distinguished: on the one side the witness' one, and, on the other side, the floristic structure of the treated variants, noticing certain species characteristic to each type of management. The floristic structure of the treated variants is significantly correlated with the general cover, mineral and organic fertilization and with the fertilization length. The administration of technological inputs produces a considerable decrease of the phyto-diversity, especially in case of the variants treated with larger quantities of fertilizers.

Key words: phyto-diversity, clusters, technological inputs

Recently, the animals effectives in Romania have considerably been diminished and, in consequence, the quantities of the resulted stable manure decreased as well (Reif *et al.*, 2008). The organic-mineral fertilization could be a realistic method of management. On the grasslands in Apuseni Mountains, this type is not being practiced, but it could be a chance to maintain the oligotrophic grasslands in the mountainous landscape. The combined use of organic and mineral fertilizers on the mountainous grassland systems, through their different ways of action, they show not only a scientific interest, but also, in equal extent, an interest for the practices of the area's farmers. This paper's objective is to survey the combined effect of the organic and mineral fertilizers upon the phyto-diversity of a *Festuca rubra* L. grassland after a period of eight years of applying technological inputs.

MATERIAL AND METHOD

The field experience was installed in 2001, on a Terra Rossa type of soil, at 1100 m ASL altitude, in Gheţari village, Gârda de Sus commune, in Apuseni Mountains (Romania), a study area which corresponds to the boreal floor from the vegetation level point of view, characterised by an annual mean temperature of 4.9 ^{o}C and rainfall of 1177 mm (Păcurar *et al.*, 2009). The experience has 5 experimental variants in 4 repetitions, placed according to random blocks method. The size of experimental parcel is 20 m^2. The experimental variants are the following: V_1 = witness; V_2 = 10 t manure ha-1; V_3 = 50 N 25 P 25 K + 10 t manure ha-1; V_4 = 100 N 50 P 50 K; V_5 = 100 N 50 P 50 K+10 t manure ha-1. Natural and mineral fertilizers had been applied every year, in early spring. The floristic studies have been performed before the harvest (beginning of July) according to metric frame method (planimetric method). The harvest was carried out during the phase of *Poaceae*s' blooming, with a rotative mowing machine, at 5 cm mowing height. In this study we pursued the structural changes which appear at the phytocenosis' level in different regimes of fertilization, distinguished through the Cluster analysis. In this paper, the results obtained in the 10th year of experience are being presented.

RESULTS AND DISCUSSIONS

As consequence of applying technological inputs during eight years, the species composition is strongly affected. Thus, after statistical interpretation of the results, two clusters are being differentiated: one represented by the witness variant (with no technological inputs) and the other cluster represented by the rest of the variants which have a species structure more or less resembling (*fig. 1*).

Each of the clusters show certain species characteristic for the type of management

performed. Thus, within the species structure of the witness, certain species are present and could be indicator for the first type of management, such as: *Anthoxantum odoratum* L., *Festuca rubra* L., *Carex pallescens* L., *Luzula multiflora, Alchemilla vulgaris* L., *Potentilla erecta* L., *Rhinathus minor* L., *Plantago lanceolata* L., *Gymnadenia conopsea* L., *Arnica montana* L. *etc.* (Table 1). For the variants where technological inputs have been made, other species are characteristic and prefer this type of management: *Agrostis capillaris* L., *Vicia cracca* L., *Centaurea pseudophrygia* L., *Pimpinela major* L. and *Veronica chamaedrys* L.. To be noticed is that certain plants which were present within the witness' species composition (cluster 1) are no longer being seen in the species composition of the treated variants (cluster 2), such as: *Arnica montana* L., *Carlina acaulis* L., *Gymnadenia conopsea* L., *Hieracium aurantiacum* L. etc., among them, some having conservative value. The Detrended Correspondences Analysis (DCA) shows that the species composition of the treated variants (cluster 2) is strongly correlated with the following factors: general cover, fertilization length, NPK fertilization and manure fertilization (*fig. 2*). The influence of the factors upon the species structure within the treated variants shows a very significant statistical assurance, except the stable manure, which shows a significant correlation.

Applying technological inputs generates a decrease of the phyto-diversity (*fig. 3*.). The first three variants own a species' diversity superior to the ones with large quantity of fertilizer. Even the variant with 10 t manure ha-1 and the one with 50 N 25 P 25 K +10 t manure ha-1 show a phyto-diversity slightly superior to the witness' one.

Table 1

The discriminative species for every cluster and their indicator value

Species	Cluster 1	Cluster 2	Valoarea p
Agrostis capillaris L.	0.115108	0.884892*	0.0003
Anthoxanthum odoratum L.	0.756098*	0.060976	0.014801
Festuca rubra L.	0.664537*	0.335463	0.013701
Carex pallescens L.	0.75*	0	0.0048
Luzula multiflora(Ehrh.)Lej.	1*	0	0.0003
Vicia cracca L.	0.166667	0.833333*	0.0034
Alchemilla vulgaris L.	0.761905*	0.238095	0.008001
Arnica montana L.	0.5*	0	0.033903
Campanula patula L.	0.5*	0	0.035204
Carlina acaulis L.	0.75*	0	0.004
Centaurea pseudophrigia C.A.Mey	0.124402	0.875598*	0.007101
Gymnadenia conopsea L.	0.75*	0	0.0037
Hieracium aurantiacum L.	0.5*	0	0.031903
Pimpinella major L.	0.187726	0.761507*	0.015102
Plantago lanceolata L.	0.8*	0.05	0.014701
Polygala vulgaris L.	1*	0	0.0004
Potentilla erecta L.	0.956341*	0.032744	0.0003
Prunella vulgaris L.	0.75*	0	0.004
Rhinanthus minor L.	0.642857*	0.017857	0.029803
Scabiosa columba L.*ria*	0.5*	0	0.033203
Thymus pulegioides L.	0.5*	0	0.033603
Veronica chamaedrys L.	0.05694	0.825178*	0.011901
Veronica serpyllifolia L.	0.5*	0	0.031703

*Legend: p - the probability of transgression; * - Species characteristic cluster*.

CONCLUSIONS

In After an eight years period, the administration of mineral and organic fertilizers produces important changes at herbaceos canopy level, two floristic structures being distinguished: on the one side the witness' one, and on the other side, the floristic structure of the treated variants, noticing certain species characteristic to each type of management. The floristic structure of the treated variants is significantly correlated with the general cover, mineral and organic fertilization and with the fertilization length. The administration of technological inputs produces a considerable decrease of the phyto-diversity, especially in case of the variants treated with larger quantities of fertilizers.

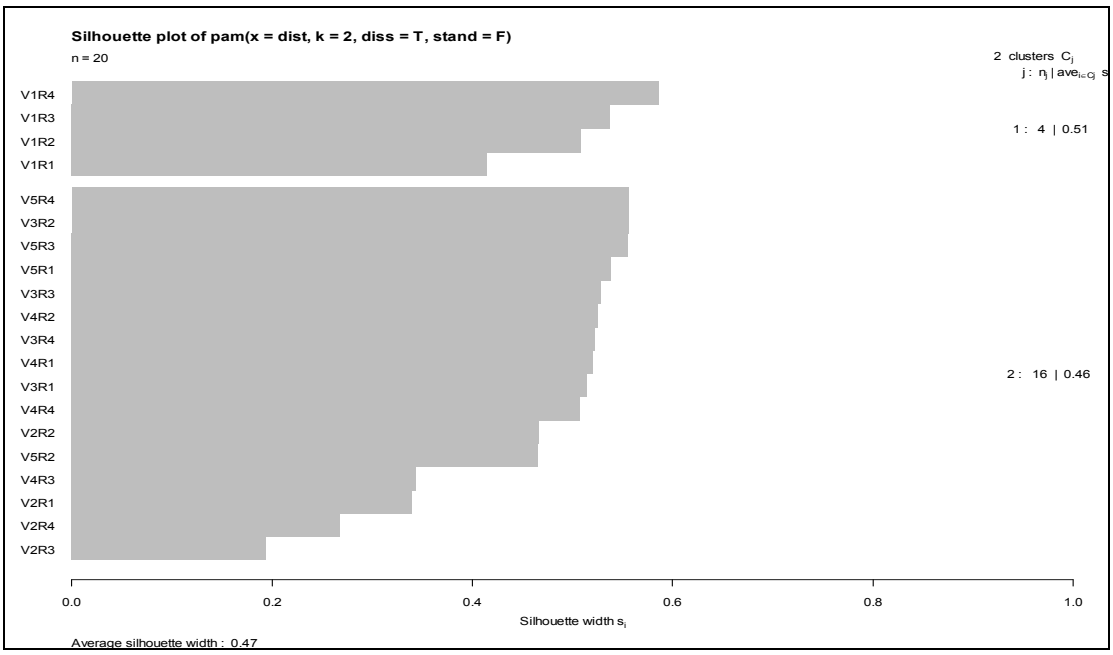

Figure 1 **Optimum number of groups and composition of each cluster after the cluster analysis through the vegetation samples' assessment around the medoid**

Legend:
V – variant,
R – repetition

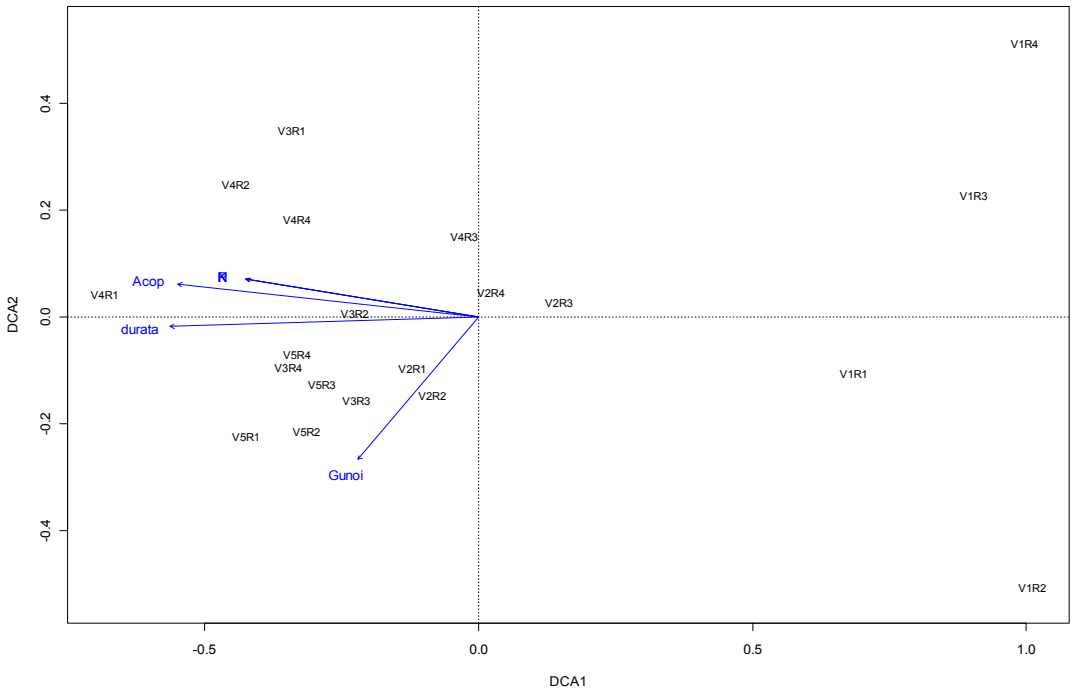

Figure 2 **The ordination of species composition and environmental variables within the ecological space of the two DCA axes**

Legend:
N – nitrogen,
Acop –general cover,
durata – fertilization length,
Gunoi - stable manure.

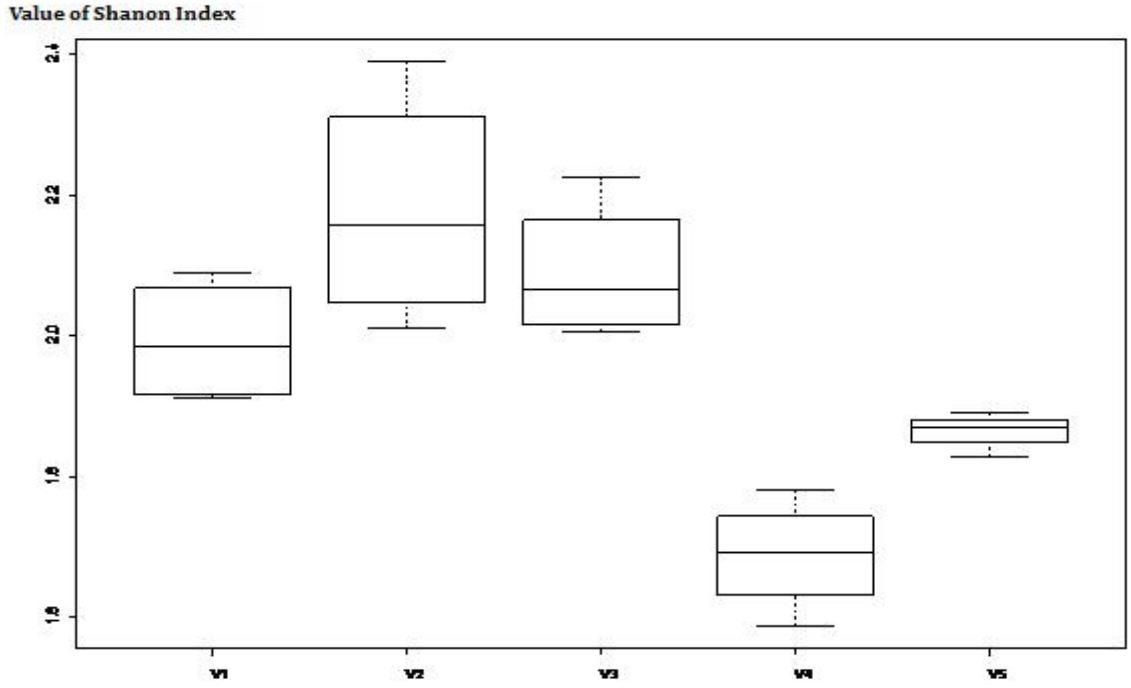

Figure 3 **Influence of organic and mineral fertilizers upon the phyto-diversity – evolution of Shannon - Wiener index**

Legend:
V – variant,
E – Experiment.

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