THE INFLUENCE OF MINERAL AND ORGANIC - MINERAL FERTILISATION ON THE HAYFIELD VEGETATION FROM BANAT (ROMANIA) HILL REGION

MARIUS COMAN, VERONICA SARATEANU, ALEXANDRU MOISUC

Banat's University of Agricultural Sciences and Veterinary Medicine from Timisoara
Faculty of Agriculture
Calea Aradului, no. 119, RO 300645
comanmario81@yahoo.com

ABSTRACT
In this study the objective was to determine the effects of mineral and organic – mineral fertilizers on the vegetation cover of a hayfield from the hill area of western Romania, respectively Fibiş (Timiş County). The average of the annual air temperature in this region is 10.7 ^{o}C and the average of the annual rainfall amount is 608 mm. The climate in the studied area is temperate continental with Mediterranean influences. The experimental field was organized by setting 6 fertilisation variants (3 mineral and 3 organic – mineral fertilisation variants) and a control non-fertilised variant. Every studied variant had three replicates. The vegetation data were collected using the linear point quadrate method, thus calculating several vegetation features. The vegetation features taken in account were: the botanical composition, the biodiversity (species richness, Shannon and Simpson indexes), some ecological indexes (temperature, humidity, soil reaction and light). The fertilisation influenced mainly the biodiversity and the light and soil reaction ecological spectre.

Keywords: hayfield, fertilisation, botanical composition, biodiversity, ecological indexes

INTRODUCTION

The aim of this research is to evidence several aspects of the fertilisation influence on the forest steppe grassland vegetation. Loss of biodiversity is a pressing problem for the biosphere. Current estimations for one of the attributes of the biodiversity – species richness – indicate that the extinction rates are higher than in the recent past and are still increasing (AGUIAR, 2005). The researches in this way are numerous there being approached different issues of this topic. Former researches developed by PAVLŮ *et al.* (2011) have evidenced that the consequent management cessation increased uniformity of grassland communities and only several dominant plant species prevailed there. The results show that some temperate grassland can be resistant to short-term perturbation by fertilisation. PIERIK *et al.* (2011) show that plant species richness can, at least partially, recover after an initial diversity decline caused by fertilization. JEANNERET *et al.* (2007) has investigated the intensity of management on the grassland biodiversity, considering the fertilisation and exploitation. The obtained results showed that for biodiversity at farm level, extensive grasslands all over the farm would be the best.

MATERIAL AND METHOD

The objective of this study is to compare different mineral and organic-mineral fertilisation doses applied on forest steppe grassland vegetation from the hill area of western Romania, respectively Fibiş (Timiş County). The research plots were set on a homogenous vegetation sector of the hayfield. The fertilisation variants applied were the following: V1 – control; V2 - $N_{100} + P_{50} + K_{50}$; V3 - $N_{150} + P_{50} + K_{50}$; V4 - $N_{100+100} + P_{50} + K_{50}$; V5 - 20 t sheep manure + P_{50}; V6 - 20 t sheep manure + P_{50} + K_{50}; V7 - 20 t sheep manure + N_{50} + P_{50} + K_{50}. The plots were set in blocks with seven variants and three replicates, each having a surface of 20 square meters (4 m x 5 m). They have been harvested by cutting twice a year. The fertilisers were applied in November 2010 and the data were collected in 2011.

The vegetation data were collected using the linear point quadrate method (DAGET *et* POISSONET, 1971). The data obtained in this way were processed for the calculation of the biodiversity indexes Shannon and Simpson. Also there were realised the ecological spectres for temperature, humidity, soil reaction and light using the indexes set by KOVACS (1979) for Romanian grasslands after ELLENBERG (1988).

The significance of the analysed ecological indexes is the following:

- **temperature (T):** 1 – species found in cold areas (boreal, arctic or alpine); 3 – species found in cool areas (mountain, subalpine); 5 – species found in temperate areas (hilly, sub-mountain); 7 – species found mainly in warm areas (plain); 9 – species found in warm areas (Mediterranean); x (0) – species indifferent for temperature;

- **humidity (U):** 1 – species found on very dry soils; 3 – species found on dry soils; 5 – species found on moderate humid soils; 7 – species found on moderate humid to humid soils (that do not dry out); 9 – species found on humid – wet soils (often airless); 10 – species found on flooded soils; x (0) – species indifferent for humidity;

- **soil pH (R):** 1 – species found only on very acid soils; 3 – species found mainly on acid soils; 5 – species found mainly on moderate acid soils; 7 – neutral soils (from moderate acid to moderate alkaline); 9 – species found only on neutral and alkaline soils; x – species indifferent for the soil pH;

- **light (L):** 1 – species found in full shade; 3 – species found in shade; 5 – species found in moderate shade (that are growing in shade but tolerate a moderate shading); 7 – species found in light (low tolerance to moderate light); 9 – species found in full light (KOVACS, 1979).

The Shannon index formula used in this work is the entropy one: $H' = -\sum_{i=1}^{S} p_i \times \ln p_i$

where: S = species number from the studied sample (species richness); p_i = percentage of the species i din S (BEALS *et al.*, 2000).

The Simpson index formula used here is: $D = \sum (n_i / N)^2 = \sum_{i=1}^{S} p_i^2$

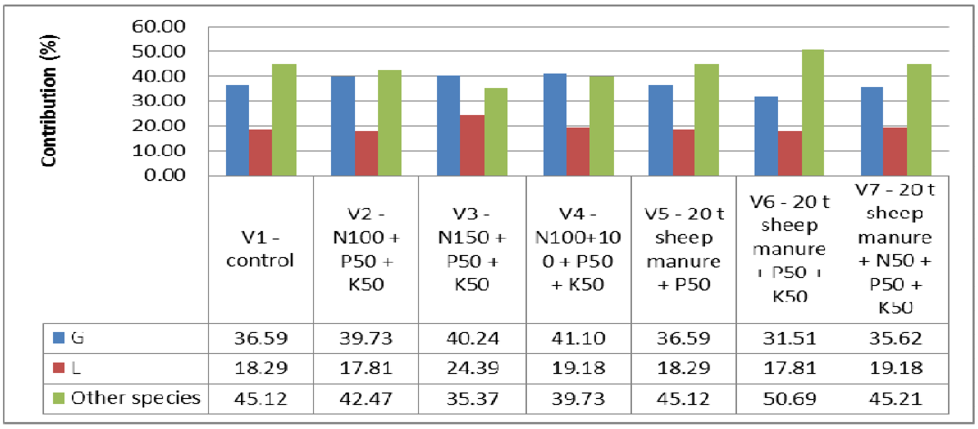
where: n_i = the total number of individuals of the species i; N = the total number of individuals of the all species from the sample; $p_i = n_i / N$ (SAMFIRA *et al.*, 2011).

RESULTS

The analysed grassland vegetation cover is dominated by *Agropyron repens* and *Festuca arundincea*. An important contribution was determined also for the following species: *Bromus hordeaceus, Poa pratensis* and *Lotus cornicultatus*. The botanical composition of the analysed fertilisation variants is presented in *Figure 1* and it shows that the chemical fertilisation has determined the increase of the grasses contribution, while the mixed fertilisation has determined the increase of the contribution of the species from other botanical families.

The total plants species number in the control plot (V1) was 29, this value decreasing in the case of the chemical fertilisation variant (V2, V3, V4) and the last organic – mineral fertilised variant (V7) (*Figure 2*). The biodiversity assessing using the Shannon index (*H'*) (*Figure 4*) and Simpson index (*D*) (*Figure 5*) have evidenced the same situation, *H'* being the inverse of *D*. According to PLANTUREX *et al*. (2005), the fertilization determinates the decrease of species richness. Other researches developed by VÎNTU *et al*. (2011) show that the organic fertilizer rates triggered changes in the canopy structure by reducing the percentage of grasses, from 70% to 14-31%, and increasing the percentage of legumes.

The fertilisation doses applied have determined the increase of the percentage of species found in light (L7) and the decrease of their coverage, except V5 variant. The humidity (U) and temperature (T) spectres were slightly influenced by fertilisation. In the case of the ecological spectre for soil reaction (R), the greatest changes have been noticed in V2 (mineral) and V6 (organic-mineral).



	V1 - control	V2 - N100 + P50 + K50	V3 - N150 + P50 + K50	V4 - N100+100 + P50 + K50	V5 - 20 t sheep manure + P50	V6 - 20 t sheep manure + P50 + K50	V7 - 20 t sheep manure + N50 + P50 + K50
G	36.59	39.73	40.24	41.10	36.59	31.51	35.62
L	18.29	17.81	24.39	19.18	18.29	17.81	19.18
Other species	45.12	42.47	35.37	39.73	45.12	50.69	45.21

Figure 1. Influence of fertilisation on the floristic composition

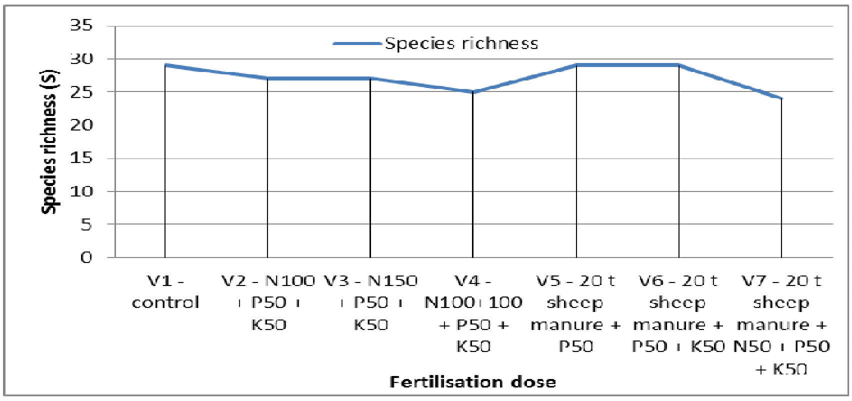


Figure 2. Influence of fertilisation on the species richness

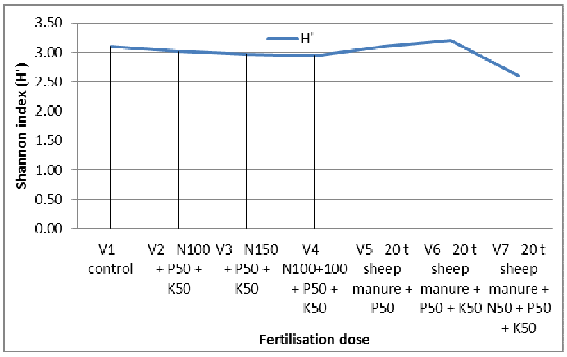


Figure 3. Influence of fertilisation on *H'*

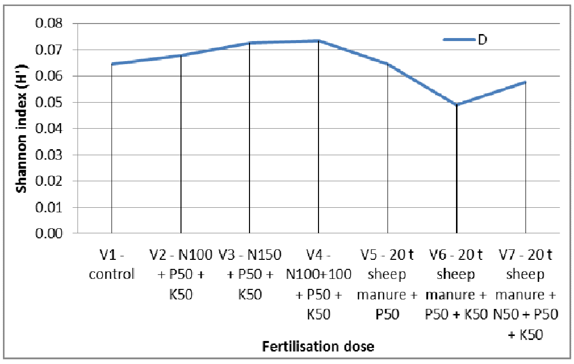


Figure 4. Influence of fertilisation on *D*

Other aspects analysed were the influence of the fertilisation on the ecological spectres for light (L) (*Figure 5*), temperature (T) (*Figure 6*), humidity (U) (*Figure 7*) and soil reaction (R) (*Figure 8*).

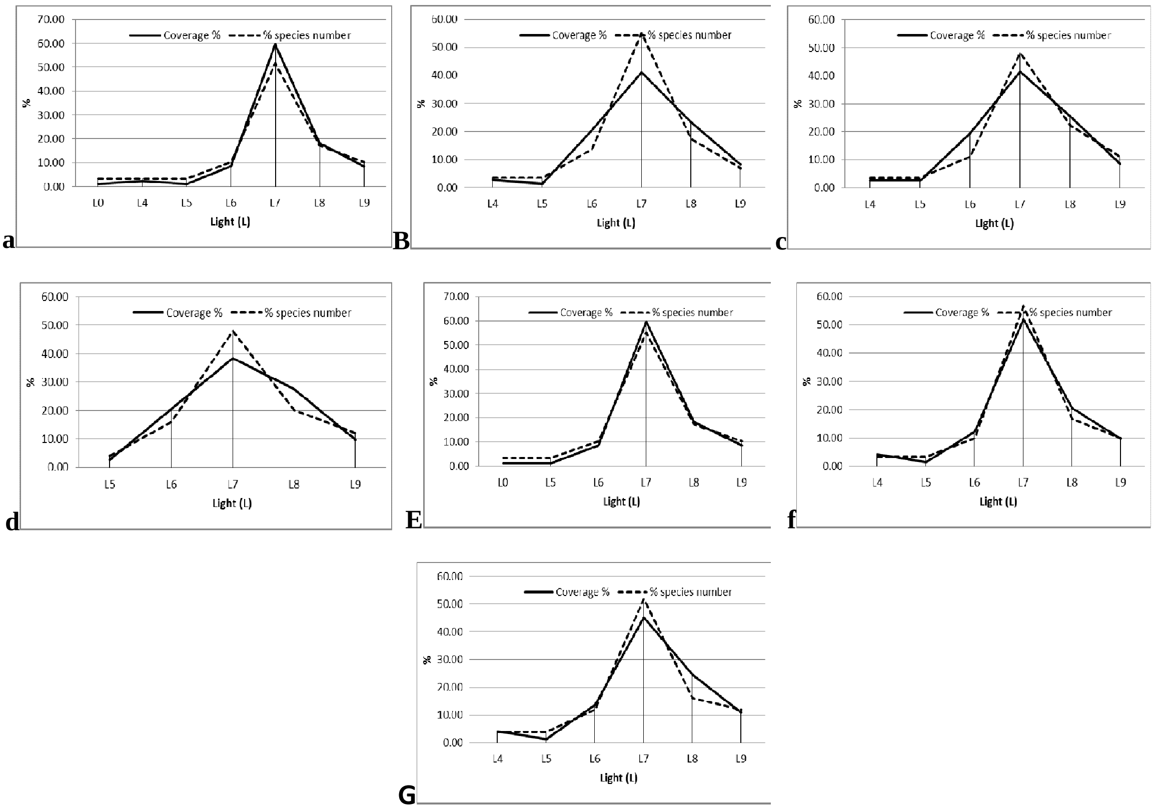


Figure 5. Influence of fertilisation on the ecological spectre for light (L) (a-V2; b-V2; c- V3; d-V4; e –V5; f-V6; g-V7)

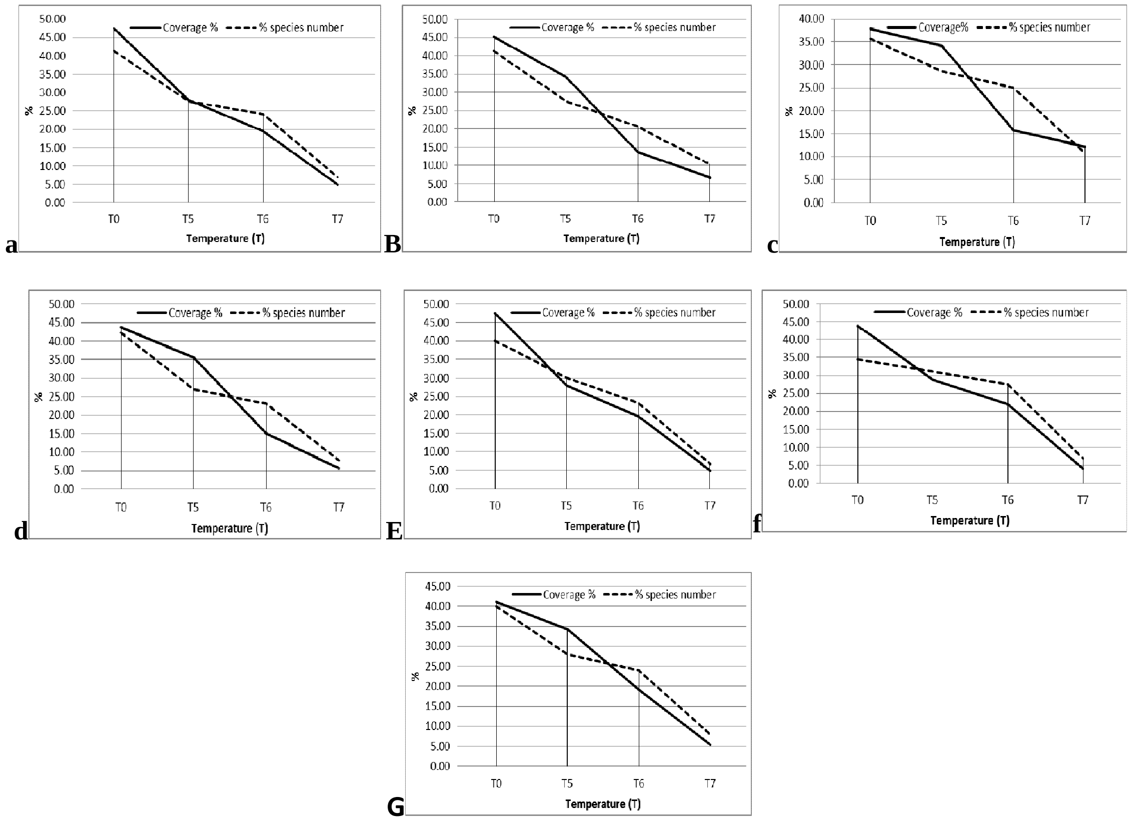


Figure 6. Influence of fertilisation on the ecological spectre for temperature (T) (a-V2; b-V2; c- V3; d-V4; e –V5; f-V6; g-V7)

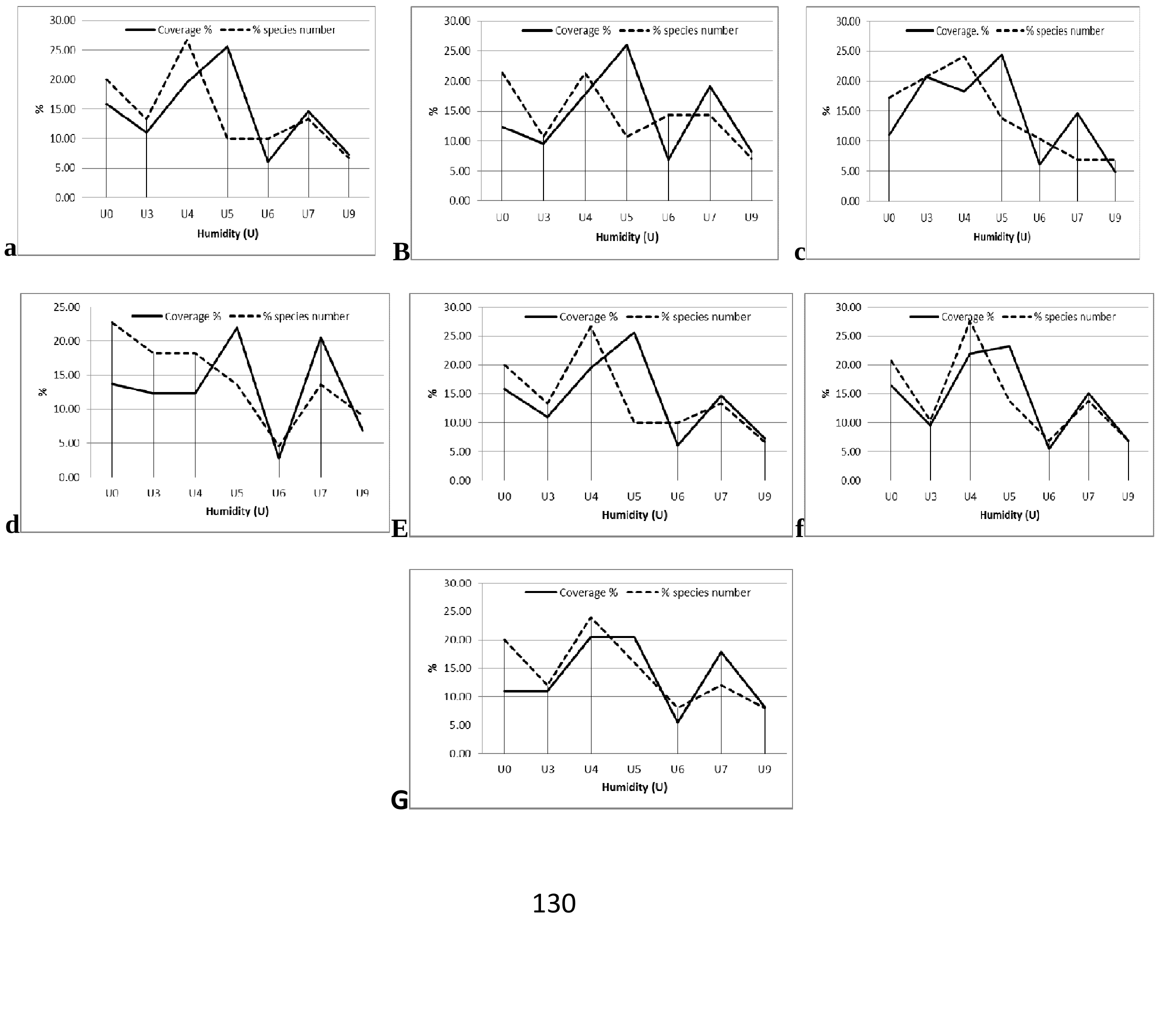


Figure 7. Influence of fertilisation on the ecological spectre for humidity (U) (a-V2; b-V2; c- V3; d-V4; e –V5; f-V6; g-V7)

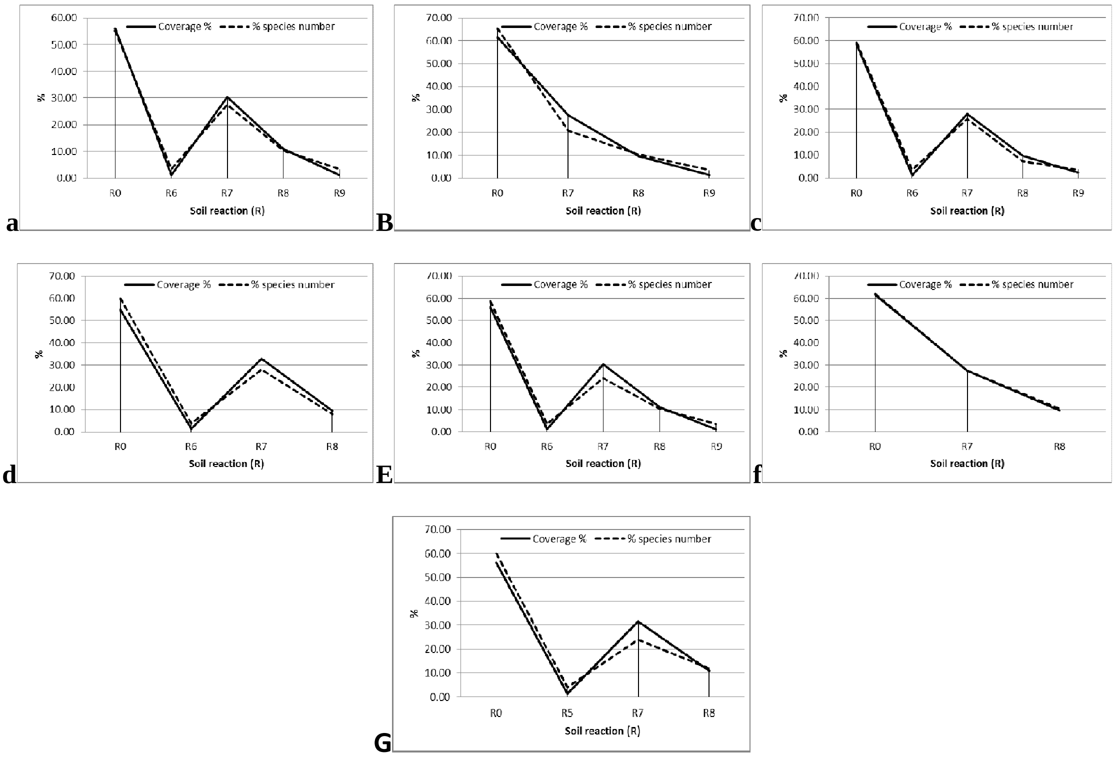


Figure 8. Influence of fertilisation on the ecological spectre for soil reaction (R) (a-V2; b-V2; c- V3; d-V4; e –V5; f-V6; g-V7)

Fertiliser supplies determinate an increase in nutrient availability for plants. In these conditions, only a few fast growing plant species can compete for light eliminating less competitive plants (PLANTUREX *et al.*, 2005). According to OBRATOV-PETKOVIĆ *et al.*, (2006) there is a correlation between hydrothermic conditions of the soil and the ecological indices of plants for moisture (F), light (L) and temperature (T).

CONCLUSIONS

The biodiversity is diminished by chemical fertilisation, the organic-mineral low doses maintaining this parameter close to the non-fertilised variant in the forest steppe grassland dominated by *Agropyron repens* and *Festuca arundinacea*. Regarding the ecological indexes, the greatest influence was evidence d in the case of light and soil reaction ecological spectres. It is recommended to be applied low fertilisation doses that will not affect the biodiversity and structure of the grassland vegetation.

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