Summary

Keywords: *Festuca valesiaca* Schleich. ex. Gaudin, permanent grasslands, organic fertilization, mineral fertilization, phytodiversity, productivity, forage quality,

Permanent grasslands are an important source of fodder, due to the areas that they occupy, but also to high and good quality production that can be obtained from them. Exact knowledge of the current potential of permanent grasslands constitute a mandatory requirement in order to capitalize on a higher level the opportunities available in this area.

By using a rational management, grassland production may rise considerably. This requires strengthened the belief that grasslands require care and improvement works like any other culture, the expenses incurred by them being recovered with greater efficiency.

Preservation and conservation of biological diversity, obtaining higher quality products requires precise knowledge of the effects of human intervention on natural biocenosis and their habitats, given the ever increasing demands of improving productivity, cost effectiveness to individual farms or association owning or operrating on areas of permanent grassland.

In this context, **this paper aims to study the influence of organic and mineral fertilization on biodiversity and forage quality obtained from *Festuca valesiaca* Schleich. ex Gaudin grasslands in Moldova forest steppe**.

The thesis objectives are to analyze sward phytodiversity under the influence of organic and mineral fertilization, analyzing the effect of organic and mineral fertilizer application on dry matter production and to highlight the values of indicators expressing forage quality.

The thesis is structured in **two parts** and **six chapters**.

In the **first part**, over 39 pages (19.6% of the thesis) are structured Chapters I, II and III, which contains a study of the literature in order to understand the **current state of research** with reference to the **influence of organic and mineral fertilization on biodiversity and forage quality obtained from the permanent grasslands** and description of natural conditions in the study area.

In **Chapter I**, **the natural area of experimentation is characterized**, also is covered the farm Ezăreni, integral part of Didactic Station of the University of Agricultural Sciences and Veterinary Medicine Iasi, located 2.5 km southwest of the city of Iasi in the south-western "Moldavian Plain" on the territory of Miroslava (47 ° 05'-47 ° 10 'north latitude and 27 ° 28'-27 ° 33' east).

The climate of the geographical area in which the Ezăreni farm is located is tempered, with features determined under the influence of the Russian steppe climate with annual average temperature of 9,7 ° C and average annual rainfall of 517,8 mm.

Prevalent soil types in the study area are typically silt cambic chernozem, chernozem cambic, aluviosol molic and saline gley soil, and from the point of view of natural vegetation that is located within Ezăreni farm falls in the forest steppe, northern sylvosteppe division, district of Northern Moldavia, Iasi sylvosteppe.

Chapter II summarizes **the introductory elements on permanent grassland**: importance, classification and distribution, as well as basic principles of grassland typology and characterization of the main types of grasslands in Romania, with focus on the pastures of the sylvosteppe.

The **third chapter** is a synthesis of the **current state of research, conducted worldwide and national productivity, biodiversity and quality of feed produced on permanent grasslands** under the influence of organic and mineral fertilization.

In **Part II**, comprising 80.4% of the doctoral thesis (160 pages), are presented the **results of research on the influence of organic and mineral fertilization on biodiversity and forage quality obtained from *Festuca valesiaca* Schleich. ex Gaudin in Moldova forest steppe.**

In **Chapter IV** are presented the **goals, objectives and activities of the study, research methods, cultural practices applied** and a description of the **weather conditions during the experimentation period.**

To achieve the goals and objectives, in the autumn of 2010 were started, in the Ezăreni farm, two monofactorial experiments, arranged by the method of randomized blocks in three replicates, each with nine variants of fertilization. A testing variant had an area of 12 mqs (3x4 m), harvested area being 7,50 mqs (2,5 x3,0) and the total surface area was 432 mqs (36 x 12 m).

Experience I - fertilization with organic fertilizers, from sheep and cattle with the following experimental variants: V_1 - unfertilized control, V_2 - 10 t/ha sheep manure annually, V_3 - 20 t/ha sheep manure every two years, V_4 - 30 t/ha sheep manure every three years, V_5 - 40 t/ha sheep manure every three years, V_6 - 10 t/ha cattle manure annually, V_7 - 20 t / ha cattle every two years, V_8 - 30 t/ha cattle manure every three years, V_9 - 40 t/ha cattle manure every three years.

Experience II - fertilization with mineral and organic fertilizers, with the following experimental variants: V_1 - unfertilized control, V_2 - manure 10 t/ha per year + $N_{50}P_{36}$, V_3 - manure 10 t/ha per year + N_{50+50} P_{72}, V_4 - manure 20 t/ha every 2 years + $N_{50}P_{36}$, V_5 - manure 20 t/ha every 2 years + $N_{50\,+\,50}P_{72}$, V_6 - manure 30 t/ha every 3 years + $N_{50}P_{36}$, V_7 - manure 30 t/ha

every 3 years + $N_{50+50}P_{72}$, V_8 - manure 40 t/ha every 3 years + $N_{50}P_{36}$, V_9 - manure 40 t/ha every 3 years + $N_{50+50}P_{72}$.

To determine the floristic composition we used the **geobotany method**. The typological characteriyation of grasslands was done after **Ţucra I. *et al.*, 1987**. Floristic composition studies were performed before mowing, at the earing-flowering stage of dominant grasses, using the visual assessment scale - **Braun-Blanquet method**.

For analysis of vegetation we determined **species richness**, later it was used to calculate the **Shannon- Wiener diversity index** and **abundance – dominance mean values**.

Floristic data interpretation was accomplished using PC-ORD software, which performs multivariate analysis of ecological data (**B. McCune and J.B. Grace, 2002**), using specific functions and methods: Summary (for determining the number of species and Shannon index), the average frequency and dominance, MRPP method (Multi Response Permutation Procedure) and multidimensional scaling NMDS.

Determination of the production was done at each harvest cycle by individual weighing of green mass harvested from each variant and reporting its ratio per hectare Analysis of quality parameters was conducted in Plant - Soil Laboratory at the University of Agricultural Sciences and Veterinary Medicine "Ion Ionescu de la Brad" Iasi which included the following determinations on obtained forage: dry matter content (DM) and crude protein (PB), the content of NDF (neutral detergent fiber) and ADF (acid detergent fiber), relative feed value (RFV).

Statistical interpretation of experimental results was performed by analysis of variance and limit differences calculation method and regression by calculating correlations between the doses of fertilizers applied and yield and quality parameters analyzed.

In terms of climate, agricultural period 2010-2013 was slightly in excess of the average regarding air temperature, which was between 10,4 to 10,8 ° C, with 0,2-0,8 ° C higher than the multiannual average, and during the growing season with a positive deviation of 0,6 to 2,2 ° C above the annual average.

The amounts of rainfall are different in each of the three years of study. Agricultural year 2010-2011 was close to a normal year. Annual amount of rainfall was 12,6 mm less than the multiannual average, and the amount of rainfall recorded during the vegetation period was 28,1 mm greater than the annual average.

Agricultural year 2011-2012 was a dry year, the total annual rainfall being with 162,4 mm lower than the annual average. The amount of rainfall recorded during the growing season (April-September) was 92,3 mm less than the annual average.

Agricultural year 2012-2013 was rich in rainfall, the annual amount of rainfall being 926,4 mm, 408,46 mm greater than the multiannual average, and the one recorded during the growing season was 158,3 mm higher than the annual average.

Chapter V presents **the results of research on the effect of organic and mineral fertilizers on phytodiversity of *Festuca valesiaca* Schleich. ex Gaudin grasslands.**

Following studies on the floristic composition of this grassland, we identified the grassland type *Festuca valesiaca* Schleich. ex Gaudin - *Medicago falcata* L., which is part of *Festuca valesiaca* Schleich. series, specific for the sylvosteppe zone.

Under organic fertilization, in 2011, the floristic structure of *Festuca valesiaca* Schleich. ex Gaudin - *Medicago falcata* L. phytocoenosis was: *Poaceae* 28,0%, 21,6% *Fabaceae* and 48,0% species from other botanical families, with an overall coverage of 99,0%. Regarding phytodiversity, Shannon index recorded an average of 2,9, and the number of species was 35, which shows that this phytocoenosis had an above average floristic diversity.

In 2012, the *Poaceae* coverage showed slight increases following the application of organic fertilizers in most experimental variants and the *Fabaceae* increased from 16,2% in control, to 22,5% in the variant fertilized with 20 t/ha cattle manure every two years (V_7). Application of fertilizers leads to the disappearance from vegetation of a number of 15 species, thereby decreasing floristic diversity.

Floristic structure in 2013, had a different evolution compared to previous years. The *Poaceae* family grew up to 69,2%, and *Fabaceae* changing participation under the influence of organic fertilizers, increasing coverage only at variants V_2 (10 t/ha sheep manure annualy) and V_6 (10 t/ha cattle manure annually), reaching 25,3% and 22,8%, and the coverage of forbs showed a slight increase in variant V_2 (10 t/ha sheep manure annually).

Under organic and mineral fertilization, in 2011, the *Poaceae* participation had a large increase compared to the control, with a value of 80%, the *Fabaceae* reduced to 5,5%, and forbs decreased from 25,6% in control to 14,3% in the variant fertilized with 40 t/ha cattle manure every 3 years + $N_{50+50}P_{72}$ (V_9).

In 2012, *Poaceae* coverage increased from 46,4% (control) to 83% in the variant fertilized with 40 t/ha cattle manure every 3 years + $N_{50+50}P_{72}$ (V_9). *Fabaceae* registered a negative trend in most experimental variants, reaching a participation of 2,8% in the variant V_4 (20 t/ha cattle manure every 2 years + $N_{50}P_{36}$). Fertilization application led to the extinction of 13 species and an apparent decrease of phytocoenosis biodiversity.

In 2013, were observed the same changes due to the influence of fertilizer. Thus, a more pronounced increase of *Poaceae* detrimental to *Fabaceae* and forbs was registered. Biodiversity has reached its lowest level in the experimental period, the number of species decreased to 20 (V8 - 40 t/ha cattle manure every 3 years + N_{50} P_{36} and V_9 - 40 t/ha cattle manure every 3 years + $N_{50\ +50}$ P_{72}) compared to the control, which showed an average of 39,2, and Shannon index of diversity in the V_3 (10 t/ha bovines per year + N_{50+50} P_{72}) dropped to 1,88.

During the three experimental years, the application of manure favored species as: *Trifolium montanum* L., *Trigonella caerulea* (L.) Ser., *Dianthus carthusianorum* L., *Koeleria macrantha* (Ledeb.) Schult., *Cardaria draba* (L.) Desv., *Eryngium campestre* L., *Carex distans* L., *Heracleum sphondylium* L., *Eryngium planum* L., *Euphorbia agraria* M. Bieb. etc, and the application of mineral fertilizers favored species such as: *Bromus inermis* Leyss., *Arrhenatherum elatius* (L.) Beauv. ex J. et C. Presl., *Astragalus onobrychis* L., *Vicia hirsuta* (L.) Gray, *Tragopogon pratensis* L. ssp. *orientalis* (L.) Čelak., *Veronica chamaedrys* L. etc.

Chapter VI presents **results of research on the effect of organic and mineral fertilizers on productivity and forage quality obtained from permanent grassland.**

Grasslands fertilization with organic and mineral fertilizers had a positive effect on increasing production, the levelof which being differentiated according to the doses used and their combinations.

Applying organic fertilizers resulted in an increase in total production of dry matter in all variants of fertilization, compared with unfertilized variant production. The highest production of 4,93 t/ha DM was recorded in 2013 in variant V_9 (40 t/ha cattle manure every 3 years), an increase compared to the control by 103% and the lowest 2,12 t/ha DM in 2012, in the variant V_5 (40 t/ha sheep manure every 3 years), however, with an increase of 36% compared to the control (V_1).

Organic fertilizers have positively impacted the quality of forage obtained from the grassland studied. Crude protein content increased significantly compared to the control variant, in all the years of experimentation. The most significant increase was recorded in 2011, in the V_8 variant (30 t/ha cattle manure every 3 years) with a value of 11,46 g/100g DM superior to controll variant with 61,9% and the lowest crude protein content to registered in the variant fertilized with 40 t/ha sheep manure every three years (V_5) of 7,61 g/100g DM in 2013, 1,6% higher compared to the control variant.

The same positive effect on forage quality had the combined fertilizer application (mineral and organic). Crude protein content recorded significant growth from one year to another, in all fertilized variants. The highest crude protein content was determined in 2012 in the variant fertilized with 10 t/ha manure per year + N_{50} P_{36} (V_2) with a value of 12,45 g/100g DM superior to control variant with 63,4%. The lowest crude protein content was recorded in 2013, in the variant fertilized with 20 t/ha manure every 2 years + N_{50+50} P_{72} (V_5) with a value of 8,84, still 13,9% higher compared to the control.

Values of NDF content during the three experimental years were influenced by fertilization with manure, observing a decrease in the feed content to this parameter, the lowest value was recorded in 2011, in the variant fertilized with 30 t/ha cattle manure every three years (V8), 53,6 g/100g DM, 29,7% lower compared to the control.

Under organic and mineral fertilization, the forage content in NDF obtained from permanent grassland showed a downward trend with increasing the amount of fertilizer applied. The lowest NDF content was observed in the variant fertilized with 40 t/ha manure every 3 years + N_{50} P_{36} (V_8), in 2012, with a value of 56,7 g/100g DM, 21,5% lower compared to the control.

Results during the three experimental years, both in the experiment with organic fertilizer and the experiment with combined organic and mineral fertilization, regarding ADF content of the feed, highlight the influence that fertilization has on this parameter, causing a decrease in all experimental versions, compared with control variant.

Application of organic and mineral fertilizers also had a positive influence on relative feed value (RFV), all fertilized variants recorded significant increases, distinct and very significant compared to the control. The highest value RFV, in the organic fertilized experiment was recorded in 2011, in V_8 variant (30 t/ha cattle manure every 3 years), being 99,4, with a 36,0% increase compared to unfertilized variant. Under combined mineral and organic fertilization, the highest value of RFV was registered in V_8 variant (40 t/ha manure every 3 years + $N_{50}P_{36}$), 93,6, 36,1% higher compared to the control variant.

At the end of the thesis we present the conclusions and recommendations that have emerged from this study, as well as a selection of references consulted during the conduct of this work.