

## ABSTRACT

At national level there are over 4.8 million hectares of permanent grassland, which is an important source of feed for the livestock sector of agriculture. In the region of Oltenia, from the agricultural area of about 1.9 million hectares, approximately 465 thousand hectares are grassland, with the highest weight in the hilly and mountainous regions. Because of these important areas, it is necessary to find and to use those technological measures to ensure the highest yields in terms of quantity and quality, economic efficiency, within a rational exploitation. Meadows, pastures and grassland are considered natural ecosystems and are the dominant components of the rural environment with a greater biological diversity than cultivated areas. In Romania these ecosystems have a large percentage, since only in the mountain area is 3.2 million hectares of agricultural land, of which about 2.5 million hectares of permanent grassland. We should be aware that especially in mountainous areas and the hill areas these ecosystems are particularly sensitive and fragile. Soils have a natural acidity that substantially influences the composition of natural flora feed. Good agricultural practice, with considerable economic and environmental benefits, is the rational exploitation by grazing with animals and organic fertilization.

In this respect this paper was conceived and which lasted over 3 years (2005-2008). 2 experiments were placed in representative locations of hilly and mountainous areas of Oltenia, in the Experimental Centers for Agricultural grasslands of Preajba (*Agrostis capillaris* meadow) and Ranca (*Nardus stricta* meadow), at the same time researching the *application of*

*organic fertilizers and amendment and organic and mineral fertilization of permanent pastures.*

During the research the major objectives pursued were: knowledge of the main types of permanent grassland located in the hilly and mountain regions of Oltenia, increased production, improved flower and chemical composition of *Agrostis capillaris* and *Nardus stricta* grasslands by applying of organic and chemical fertilizers, and amendments, establishment of optimal application system of these fertilizers, flower structure variation of the hill and mountain pastures according to fertilization and amendment, the development of specific biodiversity of pastures under the influence of organic fertilizers, assessing the economic efficiency of organic and organic and mineral fertilization.

The thesis is divided into 9 chapters, plus an introduction, general conclusions and recommendations, bibliography and appendices.

The first chapter presents experimental results obtained in our country and even abroad, to improve the productivity of permanent pastures in the hilly and mountainous regions with organic fertilizers, being highlighted their effect on dry matter production, flower composition, chemical composition of plants, soil characteristics, in terms of using various forms of organic fertilizers used on meadows (manure, liquid organic fertilizer, etc.).

The second chapter presents the natural environment in which the experiment took place, including information about geographical location, terrain, climate, soil, natural vegetation, and specific climatic conditions encountered in 2005-2008. The Experimental Center for Agricultural grasslands of Preajba is located within the administrative town of Tg. Jiu, it is at an altitude of about 300 m, the highest terrace of the River Jiu (terrace V) on a plane ground with a small exhibition about the west and south-west, the soil type encountered is being *Luvosol Albic* on clays. From the multi-annual weather data recorded is shown that the average temperature is 10.2<sup>0</sup> C and

the precipitation total 770 mm. In the research years the climatic conditions were different from the multi-annual average.

The Experiment Field of Ranca, located in the north of Gorj County, situated at an altitude of 1600 m on land with a slope of about 15° with southwest exhibition on Corne u Mare Mountain and the soil type is *districambosol*. The climate is typical of mountain, cool and wet with an active atmospheric dynamics (3.8° C average annual temperature, rainfall of 1338.1 mm).

In Chapter three are set objectives that were intended to be pursued in the present paper and the research method used to refer to works that were performed in the field and in the laboratory phase. The theme of research has resulted in two experiments: *Research on the application system of organic fertilizers on permanent grassland (Theme 1)* and *Research on the amendment and organic and mineral fertilization of permanent pastures (Theme 2)*. Both experiences have been placed on the permanent grasslands from both Preajba (the hills) and Ranca (in the mountains).

The fourth chapter describes the main types of permanent grassland found in the hilly and mountainous regions of Oltenia, presenting data on floristic composition, bio-ecological indices and agronomic value of these meadows. In the hilly region have been identified: *Agrostis capillaris* meadow from Preajba, the *Festuca pratensis* meadow from Tismana and the *Crypsopogon gryllus* meadow from Tg. Carbunesti. In the mountain area were identified: *Nardus stricta* meadow on Mount Corne u Mare, *Festuca rubra* meadow in Ranca mountain and *Festuca ovina ssp Sudetica* meadow of Mount Tdivele.

Chapter five covers the presentation and interpretation of results on the dose and application system of organic fertilizers on the hill meadow dominated by *Agrostis capillaris* using doses of manure between 10 and 40 t/ha applied annually or periodically.

On average those three years of experimentation (2006-2008) the non-improved permanent grassland gave a low production of 1.38 t/ha. At treatments with organic fertilizers, yields have shown notable increases, varying between 2.14 and 3.88 t/ha d.m. The yearly treatment can be observed with 20 t/ha manure, which obtained an average production of 3.88 t/ha d.m., but also the following variants: 20 t/ha manure in the first year plus 10 t/ha manure in years II and III (2.84 t/ha d.m.), with 20 t/ha manure in the first year plus 10 t/ha manure in year II, without fertilizer in year III (2.60 t/ha d.m.), with 10 t/ha manure per year (2.56 t/ha d.m.).

Fertilization with organic fertilizer increased the proportion of legumes in grassland, represented by *Trifolium pratense* whose share reached 30% in many variants. Also, organic fertilizers have increased the raw protein percentage from 10.47% to 12.90% (40 t/ha manure in first year), decreased by 1-2 percentage points of cellulose, increasing the amount of phosphorus and potassium (to the limit or even below the optimum content, due to specific soil characteristics).

Under the economical aspect, the maximum rate of profit was recorded at the variant with a dose of 20 t/ha organic fertilizer annually.

Chapter six outlines research on organic and mineral fertilization and amendment of the permanent hill grasslands dominated by *Agrostis capillaris*, when on amended ground (6 t/ha  $\text{CaCO}_3$ ) or non-amended were used doses of manure 10-40 t/ha with 50 kg/ha  $\text{P}_2\text{O}_5$ , applied annually or periodically, and in the years when no manure was applied were used low doses of chemical fertilizers (50 kg/ha N 50 kg/ha  $\text{P}_2\text{O}_5$ ).

The limestone amendment has had little influence, insignificant, on the permanent hill grassland production, the low effect of amendment may be explained by the presence of treatments with organic fertilizers (manure) the effect of which overlaps at least partially, to that of carbonate calcium.

From the average results on 3 years is shown that the *Agrostis capillaris* meadow fertilized with organic and mineral fertilizers gave yields of 3.44 to 4.59 t/ha d.m. It is highlighted the fertilized version in the first year to 40 t/ha manure and in years II and III with chemical fertilizers in low maintenance doses (by 50 kg/ha N and P<sub>2</sub>O<sub>5</sub>) with an average production of over 4.5 t/ha d.m. Similar results were recorded also in the variant with 40 t/ha manure in years I and III and 50 kg/ha N + 50 kg/ha P<sub>2</sub>O<sub>5</sub> in year II.

Regardless of the presence or absence of amendment, organic fertilizers applied in the first year, especially doses of 30 and 40 t/ha increased the legume proportion to about 25% by mass occurrence of the species *Trifolium pratense*.

Using low doses of chemical fertilizers in the second or third years, when not fertilized with manure, have not resulted in lowering the proportion of legume in grassland.

The limestone amendments had an almost negligible influence on the chemical composition of the feed. Instead, organic fertilizers and chemical treatments increased the proportion of protein and phosphorus in feed, the potassium content remained at 2% below the allowable threshold, regardless of treatment.

The most economically viable option is that of 40 t/ha manure in the first year, followed by 50 kg/ha N and P<sub>2</sub>O<sub>5</sub> in years II and III, at which the rate of profit was 63.55% on non-amended ground and 57.14% on amended ground.

Chapter seven describes research on dosage and application of organic fertilizer system in the mountain meadow dominated by *Nardus stricta* using doses of manure between 10 and 40 t/ha applied annually or periodically.

The 3 years average data show that mountain *nardete* can be improved with organic fertilizers, the yields achieved by organic fertilization was between 1,32-1,94 t/ha d.m. (in the years of research was obtained a

production over 2 t/ha d.m.), compared with 0.76 t/ha d.m. obtained when not fertilized. Regardless of the application system, yields have remained limited, the need for other solutions for increasing quantities of forage harvested.

The recommended average dose is of 20 t/ha manure applied annually to which the dynamics of production years is more uniform. High doses (30-40 t/ha manure) applied regularly at 3 years, giving an average production close to treatment mentioned above, but each year, the production is uneven.

Organic lawn fertilizers administered in doses and different systems have increased the percentage increase of legumes, parallel with the regression of *Nardus stricta* species and “different” species.

Chemical analysis performed in experiment year II, to the plant mass harvested from the meadow of *Nardus stricta* in Ranca demonstrated the content in feed was generally low in raw protein and reduced the changes caused by fertilization with organic fertilizers.

Economic efficiency shows low returns showing a profit rate of no more than 32.3%. The most cost-effective options have proven to be low-dose or medium-sized manure applied annually or periodically (20 t/ha manure in I + 10 t/ha manure in III, or 20 t/ha in I + packs of 10 t/ha in years II and III).

Chapter eight covers research on organic and mineral fertilization and amendment of permanent mountain grasslands dominated by *Nardus stricta*, when on amended or non-amended ground (6 t/ha CaCO<sub>3</sub>) were used doses of manure 10-40 t/ha with 50 kg/ha P<sub>2</sub>O<sub>5</sub>, applied annually or periodically, and in years when it was applied manure were applied chemical fertilizer (50 kg/ha N 50 kg/ha P<sub>2</sub>O<sub>5</sub>).

In general, in the first year of application the organic fertilizers have a modest effect on the meadow, even if phosphorus is added in quantities of 50 kg/ha, giving increases in low quantitative terms (from 0.15 to 0.50 t/ha d.m.), as also the level of production.

Limestone amendment has a low efficiency, the average over the 3 years, *Nardus stricta* meadow of Ranca giving 2.58 t/ha d.m. without amendment and with 0.11 t/ha more, i. e. 2.69 t/ha d.m. with amendment, which is explained by specific floristic *nardete* structure, composed of acidophilic species and the presence of manure treatments.

On average in the 3 years, under the influence of organic and chemical fertilizers, production of dry matter varied between 1.98 t/ha in variant with 10 t/ha manure annually and 3.02 t/ha in variant with 40 t/ha manure in the first year and by 50 kg/ha N, 50 kg/ha P<sub>2</sub>O<sub>5</sub> in the second and third years. Of note the variants treated with 40 t / ha manure in the first year and by 50 kg/ha N + 50 kg/ha P<sub>2</sub>O<sub>5</sub> in the coming years, and those who also received 40 t/ha manure in I and III and 50 kg/ha N + 50 kg/ha P<sub>2</sub>O<sub>5</sub> in II.

In the 3 years of testing, the organic fertilizers have stimulated the emergence and growth of legumes in mountain meadow, even up to 25%. Limestone amendment, instead had a modest influence on these plants, and chemical fertilizers, applied in small doses, led to regression of legumes, especially since the implementation period was longer.

By applying various treatments, the chemical composition of the feed had changes in the protein content (increase from 9.52% to 13.01%), and cellulose (decrease of 1-2 percentage points).

The ninth chapter describes determinations about the evolution of specific biodiversity of the *Agrostis capillaris* and *Nardus stricta* meadows, under the influence of organic fertilizers. Both the hill and the mountain meadows fewer species were found, especially since the dose and frequency of application of organic fertilizer increased. Isolated species are subject to disappearing, while coverage of important species varies according to the recovery capacity of fertilizers as well as to competitive ability.

From the investigations carried out resulted a series of recommendations for agricultural practice, which are presented in the summary below:

For single application of organic fertilizers on *Agrostis capillaris* grassland 20 t/ha manure is recommended, given yearly.

Higher yields on the meadows of *Agrostis capillaris* are possible by administering low doses of organic fertilizers with chemical fertilizers (40 t/ha manure in the first year and by 50 kg/ha N, 50 kg/ha P<sub>2</sub>O<sub>5</sub> in the years II and III or by 40 t/ha manure in years I and III and 50 kg/ha N, 50 kg/ha P<sub>2</sub>O<sub>5</sub> in II).

Amendment, gives bonuses in reduced quantity, but if possible, it is better to be used for its beneficial influence on soil characteristics and quality of feed.

For the mountain meadow, of *Nardus stricta*, it is recommended the annual fertilization with 20 t/ha organic fertilizer or use a dose of 20 t/ha manure in the first year, followed by 10 t/ha of manure in years II and III.

Superior quantitative results can be obtained with organic and mineral treatments: 40 t / ha manure in the first year plus 50 kg/ha N, 50 kg/ha P<sub>2</sub>O<sub>5</sub> in years II and III or 40 t/ha manure in years I and III in II using the combination 50 kg/ha N, 50 kg/ha P<sub>2</sub>O<sub>5</sub>. It is also recommended, if possible, correcting soil acidity with 6 t/ha CaCO<sub>3</sub>.