ABSTRACT

Key words: temporary meadow, mixtures, fertilization, productivity, vegetation cover, PB (raw protein), NDF (neutral detergent fiber), ADF (acid detergent fiber), RFQ (relative feed value).

Temporary meadows (sown, cultivated) are meadows created by man for a specified period (1-6 years). Improving the cultivation technology of the perennial grasses and legumes mixtures and the analysis on the productivity – quality relationship, in the Central Moldavia stationary conditions, is an activity of high interest and topical.

Thus, the purpose of this study is to assess **the behavior of some perennial grasses and legumes species in the establishment of temporary meadows under the Central Moldavian Plateau conditions**.

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

In the first part that includes 43 pages representing the I, II, III chapters, it is presented a study from the specialty literature regarding the establishment of temporal meadows with perennial grasses and legumes mixtures used by mowing and grazing.

In **Chapter I**, are presented information about the temporary meadows importance and spread worldwide and in our country. Also, are described the most widespread species of perennial grasses and legumes used in establishment of cultivated mixtures. These are: *Dactylis glomerata, Lolium perenne, Festuca pratensis, Phleum pratense*, *Bromus inermis, Medicago sativa, Trifolium repens, Trifolium pratense, Lotus corniculatus*, *Onobrychis viciifolia.*

In **Chapter II** is presented *Current research state regarding the cultivation tecnologies of temporary meadows*. In this chapter are presented preliminary research conducted so far on the establishment and use of temporary meadows, worldwide and in our country.

The presentation of the *Natural conditions from the experimental area* where the study was conducted is found in **chapter III**. The researches were conducted within the Agricultural Research – Development Station Secuieni which is located in the SE Neamt County, between the geographical coordinates 26°5' of east longitude and 46°5' north latitude.

The climate is temperate continental type. The vegetation in the lower areas, is the one

characteristic to forest steppe. The soil type on which the experiences were placed, is chernozem (SRTS, 2012) and it is characterized as a soil:

- well supplied with mobile phosphor (P_2O_5 – 39 ppm); moderately stocked in nitrogen, soil nitrogen index is 2,1; well supplied in mobile potassium (K_2O – 161 ppm); weakly acidic, with pH values (in aqueous suspension) of 6.29; poorly fertile, with humus content of 2.3%.

The second part comprises 145 pages of the thesis volume and are presented the research results on the behavior of some perennial grasses and legumes species in simple and complex mixtures used for hay and mixed.

In **Chapter IV** are presented the importance, purpose, research objectives, research material and methods, .

To achieve the proposed purpose and objectives, at SCDA (ARDS) Secuieni, Neamt county, in the spring of 2013, were set up two bifactorial experiments placed after the subdivided parcels method in four repetitions with the parcel dimensions of 1x10 m (10 m^2), and the harvested area of 8 m^2 (1x8 m), the total area of the experiences being of 1286.5 m^2 (41.5x31 m) and 788.5 m^2 (41.5x19 m). Thus:

The first experience: (usage – hay) 4x5 type, where the A factor is represented by the fertilization, with four graduations: a_1-N_0P_0; a_2-$N_{40}P_{40}$; a_3-$N_{80}P_{40}$; a_4-$N_{80+40}P_{40}$, and the B factor, the mixture between the perennial grasses and legumes, with five graduations: b_1 - 20% grasses + 80% legumes (20% *Dactylis glomerata* L. + 80% *Medicago sativa* L.) – control variant; b_2 - 65% grasses + 35% legumes (30% *Bromus inermis* Leyss + 35% *Dactylis glomerata* L. + 35% *Onobrychis viciifolia* Scop.); b_3 - 70% grasses + 30% legumes (30% *Dactylis glomerata* L. + 40% *Lolium perenne* L. + 20% *Medicago sativa* L. + 10% *Lotus corniculatus* L.); b_4 - 70% grasses + 30% legumes (30% *Festuca arundinacea* Schreb. + 20% *Dactylis glomerata* L. + 20% *Festuca pratensis* Huds. + 20% *Medicago sativa* L. + 10% *Trifolium pratense* L.); b_5 - 80% grasses + 20% legumes (45% *Festuca pratensis* Huds. + 35% *Festuca arundinacea* Schreb. + *Trifolium pratense* L. 20%).

The second experience: (mixed usage – one harvest in hay regime, at the earing of the dominant grasses and the buding of legumes and four harvests under the grazing simulation regime, at every 28 days) of 4x3 type, where the A factor is represented by the fertilization, with four graduations: a_1-N_0P_0; a_2-$N_{40}P_{40}$; a_3-$N_{80}P_{40}$; a_4-$N_{80+40}P_{40}$, and the B factor, the mixture between the perennial grasses and legumes, with three graduations: b_1 – 85% grasses (60% *Dactylis glomerata* L. + 25% *Lolium perenne* L.) + 15% legumes (15% *Lotus corniculatus* L.); b_2 – 90% grasses (20% *Dactylis glomerata* L. + 70% *Lolium perenne* L.) + 10% legumes (5%

Lotus corniculatus L.+ 5% *Trifolium pratense* L.); b$_3$ – 90% grasses (70% *Dactylis glomerata* L. + 20% *Bromus inermis* Leyss) + 10% legumes (10% *Lotus corniculatus* L.).

In making the mixtures it was use a diverse genetic material, represented by five species of perennial grasses and four species of legumes. At the perennial grasses were used the varieties: Intensiv (*Dactylis glomerata* L.), Doina (*Bromus inermis* Leyss), Mara (*Lolium perenne* L.), Barelite (*Festuca arundinacea* Schreb.), Barvital (*Festuca pratensis* Huds.), and at the legumes, Mihaela (*Medicago sativa* L.), Splendid (*Onobrychis viciifolia* Scop.), Rotrif (*Trifolium pratense* L.) and Giada (*Lotus corniculatus* L.).

To materialize the study activities, were made determinations on the floristic structure of the vegetation cover after the gravimetric method, following the floristic evolution on the group of species (grasses, legumes and species from other botanical families), determination of dry matter content, PB (raw protein), NDF (neutral detergent fiber), ADF (acid detergent fiber) and RFQ (relative forage quality).

The making of all the observations, measurements and analyzes were made in accordance with the experimental techniques norms and standards. The obtained data were statistically interpreted through the variance analysis and the limit differences calculation. There were calculated the correlation regressions between the quantity of applied nitrogen and the dry matter production, but also the correlation regressions between the quantity of applied nitrogen and the PB (RP), NDF, ADF and RFQ content of the feed at each of the studied mixtures.

The 2013-2015 agricultural period, in terms of climate, regarding the air average temperature compared with the multiannual average, was redundancy, the deviation being between 0.4-2.1ºC, and during the vegetation period the deviation was between 0.6-2.8ºC.

The 2013-2014 agricultural year, was characterized as a dry year, during the summer were recorded large fluctuations of temperatures and precipitations. The annual amount of precipitations was of 498.7 mm, with 49.3 mm less than the multiannual average (548.0 mm), and the annual amount of rainfall during the vegetation period (April – September) was of 377.9 mm, with 15.3 mm less than the multiannual average of 393.2 mm.

In terms of rainfall, the 2014-2015 agricultural year was a very dry year, with a deviation from the multiannual average comprised between -3.7 mm in February and -60.4 in May. During the vegetation period (April – September), the amount of recorded rainfall was of 133.8 mm, with 257.5 mm lower than the multiannual average, of 391.3 mm.

In **Chapter V** are presented the *research results on the behavior of some perennial grasses and legumes in mixtures in order to establish the temporary meadows exploited as hay and mixed*, during 2013-2015.

From the results obtained at the simple and complex mixtures, it is noted that the fodder production was influenced by the fertilization, the mixture type, temporary meadows year of existence, but also by the climatic conditions during the research period.

During 2014-2015, at the experience exploited as hay, the interaction between fertilization and mixture had influenced the average production, so this was between 14.59 t/ha d.s. at the unfertilized variant sown with *Dactylis glomerata* 30% + *Lolium perenne* 40% + *Medicago sativa* 20% + *Lotus corniculatus* 10% mixture and 24.03 t/ha d.s. at the variant fertilized with $N_{80+40}P_{40}$ and sown with *Festuca arundinacea* 30% + *Dactylis glomerata* 20% + *Festuca pratensis* 20% + *Medicago sativa* 20% + *Trifolium pratense* 10% mixture. It was noted the *Festuca arundinacea* 30% + *Dactylis glomerata* 20% + *Festuca pratensis* 20% + *Medicago sativa* 20% + *Trifolium pratense* 10% mixture at all doses of fertilizer with the highest productions, between 19.42 t/ha d.s. and 24.03 t/ha d.s..

Regarding the correlations between the used nitrogen doses and the 2014 total production, it was noted that they were positive and statistically ensured, with the exception of the variant sown with *Festuca pratensis* 45% + *Festuca arundinacea* 35% + *Trifolium pratensis* 20% mixture.

In terms of the correlations between the used nitrogen doses and 2015 total production, it was found that in all the mixtures, the correlation coefficients are positive, significant. From which it is apparent the positive effect of the nitrogen fertilizers, on the perennial grasses and legumes mixtures under study.

Regarding the biomass accumulation dynamics at the studied mixtures, in 2014 it was found that in all the studied mixtures the highest productions were achieved at the first scythe, excepting the *Festuca arundinacea* 30% + *Dactylis glomerata* 20% + *Festuca pratensis* 20% + *Medicago sativa* 20% + *Trifolium pratens* 10% mixture which recorded the highest production at the second scythe. In 2015 the highest productions were obtained in the second scythe excepting the *Dactylis glomerata* 20% + *Medicago sativa* 80% (control variant) and *Dactylis glomerata* 30% + *Lolium perenne* 40% + *Medicago sativa* 20% + *Lotus corniculatus* 10% mixtures which had the highest production at the first scythe.

The mixtures structure, used in the establishment of temporary meadows, it is maintain or evolve depending on the area's pedoclimatic elements stability, technology intensification and

by the specific capitalizing methods of the respective meadow. In 2014, the mixture formed from (80% grasses + 20% legumes), *Festuca pratensis* 45% + *Festuca arundinacea* 35% + *Trifolium pratense* 20% has changed very significant the floristic composition, thus the grasses ranged between 60.7-75.4% at the first scythe and 17.4-49.5% at the third scythe. At the same mixture (80% grasses + 20% legumes), *Festuca pratensis* 45% + *Festuca arundinacea* 35% + *Trifolium pratense* 20%, in 2015, the grasses participation percentage has grew from a scythe to another compared with the participation percentage into the sowing norm but also from one fertilization dose to another (N_0P_0 - $N_{80+40}P_{40}$). Under the NP fertilizers influence, the grasses participation percentage has increased, and the legumes has decreased compared with the participation percentage in sowing norm.

Due to the results obtained in 2014 it was found that the vegetation cover structure at the b_1 mixture, consisting in *Dactylis glomerata* 20% + *Medicago sativa* - 80%, was favorable to legumes, with values of 55-63%.

At b_2-b_5 mixtures, the grasses have dominated the vegetation cover structure, at the first scythe, the obtained values being of 63-70%. At the second and third scythe the ratio has changed in favor of legumes, the recorded values being of 48-68% at the second scythe and of 57-63% at the third scythe. The coverage degree with species from the various group has increased with the number of scythe, thereby at the third scythe the coverage degree was of 5-12%.

At the experience used as mixed, due to the interaction between the fertilization and mixture, the average productions obtained during 2014-2015 ranged between 8.12 t/ha d.s. at the unfertilized variant and sown with *Dactylis glomerata* 60% + *Lolium perenne* 25% + *Lotus corniculatus* 15% mixture and 15.62 t/ha d.s. in the variant fertilized with $N_{80}P_{40}$ and sown with *Dactylis glomerata* 20% + *Lolium perenne* 70% + *Lotus corniculatus* 5% + *Trifolium pratense* 5% mixture.

The correlations between the amount of applied nitrogen and dry matter productions obtained in each year of study, and on every performed scythe, are positive. The calculated correlation coefficients are significant and significant distinct.

At the mixtures with mixt usage, in 2014, were obtained a number of five scythes, at the first scythe were obtained the highest quantities of biomass, around 40% of the total volume produced, the difference being relatively evenly distributed on a downward trend, to the other harvests.

Due to the interaction between the fertilization and mixture on the percentage of the

species it was noted the mixture consisting from *Dactylis glomerata* 20% + *Lolium perenne* 70% + *Lotus corniculatus* 5% + *Trifolium pratense* 5% (90% grasses + 10% legumes), whose participation percentage of the grasses greatly decreased, between 56.9-67.2% at the first scythe and 49.6-54.5% at the fifth scythe.

In 2015, it was noted also the *Dactylis glomerata* 20% + *Lolium perenne* 70% + *Lotus corniculatus* 5% + *Trifolium pratense* 5% (90% grasses + 10% legumes) mixture, but, the grasses participation percentage has recovered nearly at the sowing norm and ranged between 83.0-89.5% at the first scythe and 74.4-82.5% at the fifth scythe.

In 2014, at the studied mixtures with mixed usage, the grasses have predominated in the vegetation cover structure, at each of the scythes, the participation percentage being on a slight decreasing trend, their place being occupied by the species from the various group, because the legumes species have participated in the vegetation cover composition with a nearly constant rate.

The results obtained on the evolution of the vegetation cover structure in 2015, have showed that the grasses participation percentage increased by about 10%, compared with 2014, and that of the legumes presented an involution compared with the first year of experimentation.

In **Chapter VI** are presented the data obtained regarding the quality of the perennial grasses and legumes mixtures used as hay and mixed, this being influenced by the administered fertilizer doses, the species participation percentage in the sowing norm, but also by the climatic conditions during the exploitation period.

The highest content of feed in PB (RP) in 2014, was achieved at the variants fertilized with $N_{80}P_{40}$ and $N_{80+40}P_{40}$ and sown with *Festuca arundinacea* 30% + *Dactylis glomerata* 20% + *Festuca pratensis* 20% + *Medicago sativa* 20% + *Trifolium pratense* 10% mixture of 16.21 g/100 g d.s., respectively 16.75 g/100 g d.s., and in 2015 the highest content in raw protein was between 15.97 g/100 g d.s. and 16.73 g/100 g d.s., at the variant sown with *Dactylis glomerata* 20% + *Medicago sativa* 80% mixture. The NDF content of the feed in the studied mixtures ranged from 45.10 g/100 g d.s. at *Dactylis glomerata* 30% + *Lolium perenne* 40% + *Medicago sativa* 20% + *Lotus corniculatus* 10% mixture to 54.14 g/100 g d.s. at *Bromus inermis* 30% + *Dactylis glomerata* 35% + *Onobrychis viciifolia* 35% mixture.

The lowest ADF content of the feed, was at the variant sown with *Festuca pratensis* 45% + *Festuca arundinacea* 35% + *Trifolium pratense* 20 % mixture, of 27.19 g/100g d.s., and the highest was recorded at the variant sown with *Bromus inermis* 30% + *Dactylis glomerata* 35% + *Onobrychis viciifolia* 35% mixture, of 32.82 g/100g d.s..

In 2014, and 2015, the best relative quality RQF of the feed was recorded at *Festuca pratensis* 45% + *Festuca arundinacea* 35% + *Trifolium pratense* 20 % mixture, of 170 units, respectively 163 units, belonging to 0 quality class – excellent feed (after Hancock D.W., 2011).

The research results on the quality of the perennial grasses and legumes mixtures, mixed exploited, showed that the highest PB (RP) content of the feed, of 16.26 g/100 g d.s., was achieved at the variant fertilized with $N_{80}P_{40}$ and sown with *Dactylis glomerata* 20% + *Lolium perenne* 70% + *Lotus corniculatus* 5% + *Trifolium pratense* 5% mixture.

The values regarding the NDF and ADF content, during the two years of experimentation were influenced by the interaction between fertilization and mixture. The variant with the lowest NDF and ADF content, was that sown with *Dactylis glomerata* 20% + *Lolium perenne* 70% + *Lotus corniculatus* 5% + *Trifolium pratense* 5% mixture, in all the fertilization doses.

The *Dactylis glomerata* 20% + *Lolium perenne* 70% + *Lotus corniculatus* 5% + *Trifolium pratense* 5% mixture, recorded the highest values of RFQ (> 140 units) at all the fertilized variants, belonging to the 0 quality class – excellent feed (after Hancock).

The results obtained during the study years, regarding the establishment of temporary meadows based on simple and complex mixtures, highlights the variant sown with *Festuca arundinacea* 30% + *Dactylis glomerata* 20% + *Festuca pratensis* 20% + *Medicago sativa* 20% + *Trifolium pratense* 10% mixture used as hay and fertilized with N_{80} and N_{80+40} doses on P_{40} agro found.

In establishing temporary meadows with mixed exploitation, it is recommended the *Dactylis glomerata* 20% + *Lolium perenne* 70% + *Lotus corniculatus* 5% + *Trifolium pratense* 5% mixture and fertilized with $N_{80}P_{40}$.