SUMMARY

The increase of the forage production, rich in proteins for the zootechnical sector in a continuous development, and ensuring the suitable prior plants for alimentary crops, require an increase of surfaces with legumes in the hill area, where soils with low natural fertility prevail.

As a perennial legume, the red clover (*Trifolium pratense*) avails on acid soils, especially if amendments and organic fertilizer are used.

The present paper took in consideration the answers to the fallowing questions:

– the influence of the limestone amendment ($CaCO_3$), manure and mineral fertilizers (NPK) on the dry matter yield of the red clover (*Trifolium pratense*) in pure stand;

– the influence of the limestone amendment, organic and chemical fertilizers on the annual yield dynamics and the forage quality of the red clover;

– the influence of the mineral fertilizers on the dry matter yield of the *Trifolium pratense* with the *Dactylis glomerata* or the *Phleum pratense* mixtures;

– the evolution of the sown meadows yield depending on the proportion between the mixture components;

– the influence of the mixture, the proportion between the components and the mineral fertilizers on floristic and chemical composition of mixtures consisting of the red clover with perennial grasses;

– the economical efficiency of the red clover *(Trifolium pratense)* crop and mixtures composed by red clover with *Dactylis glomerata* and *Phleum pratense*;

– the effect of inter – and intra – specific competition at *Trifolium pratense* and *Phleum pratense* species on the yield of dry matter and chemical composition;

– comparisons between inter – and intra – specific competition at *Trifolium pratense* and *Phleum pratense*.

In the **chapter one** are presenting some generalities related to the red clover history, spread, importance and systematics.

Chapter two refers of the researches from our country and abroad, concerning the red clover crop technology.

The **third chapter** presents the natural environment of the researches, describing the location, relief, climate, soil and vegetation conditions. The presented data show that the air temperature during the 2004 – 2008 period had monthly values higher than the average of 55 years, thus presenting the warming trend of the area. The annual precipitations in the experimental period (2004 – 2008) had an irregular distribution, the pluviometrical regime being well represented in the first year (2004 – 2005), for a good plants emergence and growth, showing a deficit in 2006 – 2007 year, when registered precipitations were under the multi-annual average. The other years (2005 – 2006 and 2007 – 2008) totalized quantities at least equal, even higher than the average.

Chapter four contains data regarding the purpose, objectives and the research methods used.

In **chapter five** are presented the experimental results regarding the influence of the amendments, organic and chemical fertilizer on the yield, annual dynamics and the chemical composition of the red clover forage from Preajba – Gorj.

For this purpose, in 2005 it was established an experiment similar to the subdivided parcels method with three factors and four repetitions as follows:

A factor – the soil amendment with two variants: a_1 – non amended; a_2 – amended with 6 t ha^{-1} calcium carbonate ($CaCO_3$);

B factor – the organic fertilization with three variants: b_1 – 0; b_2 – 20 t ha^{-1} manure; b_3 – 40 t ha^{-1} manure;

C factor – the mineral fertilization with two variants: c_1 – 0; c_2 – 50 kg ha^{-1} N, 50 kg ha^{-1} P_2O_5, 50 kg ha^{-1} K_2O.

In average for the two experimental years (2005 – 2006), the red clover crop gave 7.06 t ha^{-1} d.m. without amendment, and with 1.04 t ha^{-1} more (8.10 t ha^{-1} d.m.) when there were applied 6 t ha^{-1} calcium carbonate to correct the soil acidity.

The increases brought by the manure, depended on the applied dose; thus, the variant with 40 t ha^{-1} manure was realized 9.04 t ha^{-1} d.m., with 3.43 t bigger than variant without manure. The dose of 20 t ha^{-1} provided 8.10 t d.m. (with 2.49 t more than the control variant), sufficient to be taken into account for the practical use.

A lower quantitative growth but very significant from a statistic point of view was realized by the combination of 50 kg ha^{-1} N, 50 kg ha^{-1} P_2O_5, 50 kg ha^{-1} K_2O. In average at the red clover it was obtained a yield of 8.37 t ha^{-1} with chemical fertilizers, and 6.80 t ha^{-1} without fertilizers.

Under the combined influence of the three factors and their variants the red clover yield varied in wide limits, from 4.16 t ha^{-1} to 9.83 t ha^{-1} d.m. The largest quantity was obtained on the amended variant fertilized with 40 t ha^{-1}manure at meadow establishment and annually fertilized with 50 kg ha^{-1} N, 50 kg ha^{-1} P_2O_5, 50 kg ha^{-1} K_2O. Higher productions, over 9 t ha^{-1} d.m., were obtained to all variants with 40 t ha^{-1} manure, even of they were or not amended and chemically fertilized.

The dose of 20 t ha^{-1} manure was particularly noted when the crop received also chemical fertilization. The yield level of 8.49 t ha^{-1} (non amended) and 9.59 t ha^{-1} (amended) shows that using small doses of manure supplemented with low doses of chemical fertilizers can be considered a good solution for practice.

The red clover crop from Preajba could be economically exploited for two years. In the third year the plants massively disappeared, being present in

the soil at a rate below 20 %, leading to the abandonment of the crop and plowing to sow other crop.

Regarding the annual dynamics, in 2005 year the red clover was twice cut. The first cut had a share of 21 – 48 % from the annual yield, while the second cut proved to be more productive with a share of 52 – 79 %.

In 2006 year were made three cuts. The most productive in annual yield was the first cut, with a share of 58 – 71 %, the second cut has 22 – 34 % and the last one had 6 – 11 %.

The amendment and the organic fertilizers have increased the proportion of the protein and the decrease of the cellulose percentage. The phosphorus and the potassium from the plants were stimulated by the chemical fertilizers and the calcium content, by the amendment and the organic fertilizer.

The red clover proved to be a profitable crop, recommended for a higher turning of the acid soils. Organic fertilizers, in the dose of 20 t ha^{-1} are profitable due to the large production increases they made, the amendments do not raise the cost of production due to their low price, this bringing substantial benefits.

In the **sixth chapter** there are presented the experimental results concerning the competition relations at *Trifolium pratense* and *Phleum pratense* cultivated as monocultures and mixtures.

To study the relation of competition at *Trifolium pratense* and *Phleum pratense* in the spring of 2006 it was created an experimental device constituted by three experiments, adapted from the works of **Cruz P., Lemaire G. (1986), Rotar I. (1993), Rotar I. and colab. (1995)**.

On the first two experiments, with two factors located in subdivided plots with four repetitions, have sown pure cultures of *Trifolium pratense* and *Phleum pratense* with identical variants as following:

A factor – the fertilization: a_1 – unfertilized; a_2 – 100 kg ha^{-1} N, 50 kg ha^{-1} P_2O_5, 50 kg ha^{-1} K_2O;

B factor – distance between rows: b_1 – 15 cm (close rows); b_2 – 50 cm (distant rows).

In the third experiment was sown both species (*Trifolium pratense* and *Phleum pratense*) in alternating rows, distanced at 15 cm from each other. The experiment had a single factor with two variants: first variant – unfertilized; second variant – 100 kg ha^{-1} N, 50 kg ha^{-1} P_2O_5, 50 kg ha^{-1} K_2O.

For the *Trifolium pratense* the increased distance between rows from 15 to 50 cm led to the yield growth with 108 % per meter that shows high intra – specific competition in the case of the close rows sown, especially the particular aggressiveness of the red clover to himself.

Intra-specific competition was maintained at high intensity both on the unfertilized and the fertilized variants.

Considering the dry matter yield, *Trifolium pratense* sown in close rows obtained a superior production towards distant rows (10.76 t h^{-1} towards 6.71 t ha^{-1}) because of the better use of the nutrition area.

In the case of mixture of *Trifolium pratense* with *Phleum pratense* the legume was subject to intense competition from the grasses, and production has fallen by over 50 %.

The inter – specific competition manifested by the *Phleum pratense* on the *Trifolium pratense* was less influenced by the agrofond.

At the *Trifolium pratense* the intra – specific competition, and also the inter – specific competition with the *Phleum pratense*, had approximately equal intensities regardless of the agrofond.

For the *Phleum pratense* species, the dry matter yield increases by the use of fertilizers from 67 to 128 g this way it is evidenced the low soil fertility and also the high efficiency of the fertilizers.

Phleum pratense exerts an intense competition with itself when it grows with a high density; thus, for distant rows the yield was 131 g d.m. per row meter, and at close rows the yield fell to 63 g d.m. per row meter.

Regarding the production per area unit, the timothy grass behaved similarly to the red clover, registering a high yield at the close rows (4.25 t ha^{-1} d.m.) where the nutrition area was more efficiently exploited, as compared to the with distant rows variant (2.62 t ha^{-1} d.m.).

In mixture, the *Phleum pratense* was subjected to a inter-specific competition from the red clover. Since the yield decrease was only of 21 % we can state that the intensity of this competition was middle.

Inter – specific competition exercised by the red clover on the timothy had the same intensity both on the unfertilized and on the variant with 100 kg ha^{-1} N, 50 kg ha^{-1} P_2O_5, 50 kg ha^{-1} K_2O.

At *Phleum pratense* intra – specific competition proved to be much intense toward inter – specific competition exercised by the associated species *Trifolium pratense*. It is probable that the grasses also benefited from the biological nitrogen fixed by symbiotic bacteria from the legumes roots.

At the red clover, the high content of azoth at distant rows crop shows the existence of an intra – specific competition for this element, with a reduced intensity.

At the timothy, inter – specific competition for azoth is much stronger. In the mixture with the red clover, the timothy benefits of symbiotic nitrogen fixed by the legume.

Chapter seven comprises experimental results regarding the comportment of the *Trifolium pratense* in the mixture with the perennial grasses.

In the spring of 2005 year, at the Experimental Centre from Preajba it was placed an experiment with three factors:

A factor – the mixture, with variants: a_1 – *Dactylis glomerata* + *Trifolium pratense*; a_2 – *Phleum pratense* + *Trifolium pratense*;

B factor – the proportion between the grasses and the legumes, with variants: b_1 – 80 % grasses, 20 % legumes; b_2 – 60 % grasses, 40 % legumes; b_3 – 40 % grasses, 60 % legumes;

C factor – the fertilization with the variants: c_1 – unfertilized; c_2 – 60 kg ha^{-1} N + 50 kg ha^{-1} P_2O_5 + 50 kg ha^{-1} K_2O; c_3 – 120 kg ha^{-1} N + 50 kg ha^{-1} P_2O_5 + 50 kg ha^{-1} K_2O.

In average on the four experimental years (2005 – 2008) both temporary meadows, based on different mixtures, obtained differentiated yields, as following: mixture of *Phleum pratense* + *Trifolium pratense*, 4.79 t ha^{-1}d.m. and mixture of *Dactylis glomerata* + *Trifolium pratense*, 3.89 t ha^{-1} d.m.

The second studied element, the proportion between grasses and legumes, also determined changes of dry matter production. The highest yield, of 4.61 t ha^{-1} d.m., was registered at the proportion of 40 % grasses + 60 % legumes, and the smallest, of 4.09 t ha^{-1} d.m., at the proportion of 80 / 20 %, an intermediary quantity (4.31 t ha^{-1} d.m.) being obtained at the proportion of 60 % grasses + 40 % legumes. The partner in both mixtures was *Trifolium pratense*, a legume with a short vivacity, which participates in the vegetal carpet only two from the four years (2005 and 2006). However, the contribution of red clover to the amount of production was reflected quite suggestively, not only in these two years, but on average of the four years.

The chemical fertilization was another factor that substantially differentiated the average yield on the four years. Unfertilized, temporary meadows obtained a small yield of 2.70 t ha^{-1} d.m., about the same as middle productivity of the permanent meadows of the area. The application of an annual dose of 60 kg ha^{-1} N (in combination with 50 kg ha^{-1} P_2O_5, 50 kg ha^{-1} K_2O) increased the production by 2.25 t ha^{-1}, also doubling the doze of nitrogen (120 ka ha^{-1}) by 2.93 t ha^{-1}, the productions obtained were 4.95 t ha^{-1} respectively 5.63 t ha^{-1} d.m.

The combination of the three factors shows substantial variation of the dry matter yield, from 1.86 t ha^{-1} and 6.30 t ha^{-1} d.m.

The mixture of 80 % *Dactylis glomerata* + 20 % *Trifolium pratense*, unfertilized, gave the smallest production, the biggest one being obtained by the mixture of 40 % *Phleum pratense* + 60 % *Trifolium pratense*.

Whatever the mixture, the higher yields by 5 to 6 t ha^{-1} were obtained at the highest doze of nitrogen (120 kg ha^{-1}). The doze of 60 kg ha^{-1} was achieved between 4 and 5 t ha^{-1} d.m., and the unfertilized, 1 – 2 t ha^{-1} d.m. meadow based on *Dactylis glomerata* and about 3 t ha^{-1} d.m. meadow based on *Phleum pratense*, reduced the yields showing that the productive potential of the temporary meadows can be revealed only in the presence of fertilizers.

In terms of floristic structure, the two mixtures contained a significant proportion of legumes only during the first two years of vegetation. After that, in the third year, *Trifolium pratense* almost vanished from the vegetal carpet, it appeared occasionally as isolated bushes, without importance in the forage weight.

The report grasses / legumes from the seed mixture influenced the floristic structure, the red clover having a higher share especially where the ratio was 40/60 %. Also the proportion of *Trifolium pratense* was influenced by the doze of nitrogen, recording decreases along with increasing the dose of fertilizer.

In terms of the chemical composition, at the first cut from the second year of vegetation the proportion of the protein varied between 12.10 – 18.18 %, depending on the red clover percent in the mixture and the dose of azoth. Phosphorus and calcium from the feed have been located to the lower limits of the optimal content, also the potassium content was under the average.

Economically, the meadow sown with *Trifolium pratense* + *Phleum pratense*, has proved to be highly profitable. The lowest income was recorded at the unfertilized variant, sown with grass / legume in proportion of 80/20 % (388.31 RON ha^{-1}) and the highest at the variant with 40/60 %, fertilized with 120 kg ha^{-1} N, 50 kg ha^{-1} P_2O_5, 50 kg ha^{-1} K_2O (651.86 RON ha^{-1}).

Finally are presented the general conclusions and the recommendations for production. The paper comprises a number of 35 figures and 94 tables.