# POSSIBILITIES TO IMPROVE THE *FESTUCA VALESIACA* L. PERMANENT GRASSLANDS FROM NE OF ROMANIA

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**Abstract**

In Romania permanent grasslands represent 32 % of the total agricultural area, stretching over 4.9 million hectares, out of which 340.000 ha are located in the forest steppe area, on less productive soils, a fact that explains their inadequate botanical composition and low quality yields (Vintu V, 2003). One of the main measures taken to improve the quality level of grasslands is represented by the improvement of nutrition diet through fertilisation (Birch N.V, 1999). This paper presents the results obtained during 2006-2010 on degraded grasslands made up of *Festuca valesiaca* L., improved by means of organic and mineral fertilisation. The experience was organized on a degraded pastureland with *Festuca valesiaca* L, found at the height of 120 m, in the forest-steppe zone. In the experiment we have investigated the influence of organic and mineral fertilizers, applied at rates of 10-40 t/ha on the background of N50-100 kg/ha P36-72 kg/ha on the production and content of raw protein, celluloses and ash. The *Festuca valesiaca* L. pasturelands from the Romania's forest steppe react positively at medium organic and mineral fertilization, through the improvement of botanical composition and structure and through increasing the fodder's content in raw protein.

**Key words**: *Festuca valesiaca*, permanent grassland, manure, production

The diminution of the productive potential of the permanent grasslands from north-eastern Romania, which are found, at a percent of over 70%, on slope fields, is caused by erosion, at which unfavourable climatic conditions and their wrong management may be added (Samuil C. and col., 2010).

Permanent grasslands are an important source for supplying animal feed, on the condition of applying improvement measures, accompanied by a rational use. For a long-term period, on the permanent grasslands from Romania, no elementary management measures were applied, estimating that they could get efficient yields without technological inputs even if grazing began early in the spring and continued late in the autumn.

The increase in the productive potential of these grasslands can be done by fertilization with different rates and types of organic and mineral fertilizers. The investigations carried out until today have shown the positive effects of manure, combined with moderate rates of mineral fertilizers, which are applied on grasslands.

Meadow degradation is determined by changes that take place in plant living conditions and in the structure of vegetation *(Britaňák N. and col., 2008)*.

The permanent grasslands from northeastern Romania, situated on soils with low natural fertility, are weakly productive and have an improper flower composition. The main means for improving these grasslands consist in adjusting soil fertility, changing the dominance in the vegetal canopy and their good management. The organic and mineral fertilization and the rational use lead to substantial increases of the production, biodiversity and the fodder quality improvement.

This paper presents the results obtained during 2006-2010, on *Festuca valesiaca* L. permanent grassland, improved by fertilization with different rates and combinations of organic and mineral fertilizers.

## MATERIAL AND METHOD

The trial was carried out on *Festuca valesiaca* L permanent grassland with a low plants composition, situated at 120 m height, on a 10% slope. The soil was cambic chernozem, weakly leached, with a clayey texture and a pH of 6.5-6.7, at the depth of 0-30 cm. The climatic conditions during the testing period were characterized by mean temperatures of $9.5^0$C and mean annual rainfalls of 552.4 mm.

The experiments are single factor type, set in accordance to the randomized blocks method, in four repetitions, with 9 experimental variants: $V_1$-Unfertilized control; $V_2$-10 t/ha$^{-1}$ cattle manure applied every year+N50 kg ha+P 36 kg/ha; $V_3$-10 t/ha cattle manure applied every year + N50+50

kg/ha + P72 kg/ha; $V_4$-20 t/ha cattle manure applied every 2 years+ N 50 kg/ha + P36 kg/ha; $V_5$-20 t/ha cattle manure applied every 2 years+ N50 +50 kg/ha+P72 kg/ha; $V_6$-30 t/ha cattle manure applied every 3 years+ N50 kg/ha+P 36 kg/ha; $V_7$-30 t/ha cattle manure applied every 3 years+N50+50 kg/ha+P72 kg/ha; $V_8$-40 t/ha cattle manure applied every 3 years+ N50 kg/ha+P 36 kg/ha; $V_9$-40 t/ha cattle manure applied every 3 years+ N50+50 kg/ha+P72 kg/ha (N = nitrogen; P = phosphorus).

The manure and phosphorus were applied in autumn, while the nitrogen was applied in spring, before the beginning of the vegetation period (first decade of April).

At a rate of 1000 kg manure, the chemical composition was of 5 kg N, 3 kg $P_2O_5$ and 7 kg $K_2O$. For establishing the nutrition relations and for nutrient replacing, we have calculated the quantity of nitrogen obtained from crops and the coefficients of using nitrogen from organic, mineral fertilizers and from the combinations of used fertilizers, based on the direct relation between them and the yield size.

Harvesting was done at the ear formation of dominant grasses, and yield was expressed in dry matter (DM). The changes that took place in the structure of canopy were determined through the gravimetrical method.

## RESULTS AND DISCUSSIONS

From the data obtained during 2006-2010 we can observe that the fertilization can conduct to relatively high productions, in relation with the applied fertilizer's types and doses. No matter the combinations of the applied fertilizers, the best productions were realized at the variants where the highest doses were applied.

The obtained DM yields were influenced wery strongly by climatic conditions, type and level of organic and mineral fertilization. Analysing the production data, one may notice that in 2006, they were comprised between 2.3 t/ha DM at the control and 4.7 t/ha DM at the fertilization with 40 t/ha manure, applied every 3 years+ N50+50 kg/ha+P72 kg/ha (*tab. 1*).

In 2007, the vegetation of permanent grasslands was highly affected by the long-term drought that dominated the testing area of Ezăreni. In that year, yields were comprised between 1.5 t/ha DM at the unfertilized control and 2.6 t/ha DM at the fertilization with 40 t/ha cattle manure, applied every 3 years+ N50 + 50 kg/ha + P72 kg/ha Therefore, the productivity was greatly diminished, resulting in a very low effect of fertilization on production.

The yields obtained in 2008 were higher than those obtained in the previous years, being comprised between 6.2 t/ha DM at the unfertilized control and 11.3 t/ha DM at the fertilization with 40 t/ha cattle manure, applied every 3 years+ N50 +50 kg/ha+P72 kg/ha. The yields obtained in 2009 being comprised between 2.0 t/ha DM at the unfertilized control and 3.6 t/ha DM at the fertilization with 40 t/ha cattle manure, applied every 3 years+ N50 +50 kg/ha+P72 kg/ha.

Table 1

**Influence of fertilization on dry matter production (t/ha)**

| Fertilization variant | 2006 | 2007 | 2008 | 2009 | 2010 | t ha ¯1 | Dif. | Semnif. |
|---|---|---|---|---|---|---|---|---|
| Unfertilized control | 2.3 | 1.5 | 6.2 | 2.0 | 2.9 | 3.0 | - | - |
| 10 t/ha manure every year+$N_{50}$ $P_{36}$ | 3.4 | 2.2 | 8.7 | 2.6 | 3.9 | 4.2 | 1.2 | ** |
| 10 t/ha manure every year+$N_{50}$+$_{50}$ $P_{72}$ | 3.7 | 2.4 | 9.4 | 2.7 | 4.2 | 4.5 | 1.5 | *** |
| 20 t/ha manure every 2 years+$N_{50}$ $P_{36}$ | 3.5 | 2.3 | 9.0 | 2.4 | 5.0 | 4.4 | 1.4 | ** |
| 20 t/ha manure every 2 years+$N_{50}$+$_{50}$ $P_{72}$ | 3.9 | 2.5 | 10.3 | 2.9 | 4.1 | 4.7 | 1.7 | *** |
| 30 t/ha manure every 3 years+$N_{50}$ $P_{36}$ | 3.9 | 2.6 | 8.4 | 2.8 | 5.1 | 4.6 | 1.6 | *** |
| 30 t/ha manure every 3 years+$N_{50}$+$_{50}$ $P_{72}$ | 4.1 | 2.6 | 10.3 | 3.1 | 6.7 | 5.4 | 2.4 | *** |
| 40 t/ha manure every 3 years+$N_{50}$ $P_{36}$ | 3.9 | 2.3 | 9.3 | 2.8 | 5.2 | 4.7 | 1.7 | *** |
| 40 t/ha manure every 3 years+$N_{50}$+$_{50}$ $P_{72}$ | 4.7 | 2.6 | 11.3 | 3.6 | 6.6 | 5.8 | 2.8 | *** |
| **Average** | **3.7** | **2.4** | **9.2** | **2.8** | **4.9** | **4.6** | **1.6** | **-** |
| LSD 5 %= 0.8 t/ha; LSD 1 %= 1.2 t/ha; LSD 0.1 %= 1.5 t/ha | | | | | | | | |

The yields obtained in 2010 being comprised between 2.9 t/ha DM at the unfertilized control and 6.7 t/ha DM at the fertilization with 30 t/ha cattle manure, applied every 3 years+ N50 +50 kg/ha+P72 kg/ha.

The mean yields obtained during 2006-2010 were comprised between 3.0 t/ha DM at the control and 5.8 t/ha DM at the fertilization with 40 t/ha cattle manure, applied every 3 years + N50 +50 kg/ha+P72 kg/ha.

The yields uniformity may be noticed, irrespective of the used fertilization level. Analysing the mean yields, we found that their augmentation was due to the increase in the applied manure rate and, especially, to the increase in the rate of mineral fertilizers. The highest yields were obtained at the fertilization with 40 t/ha cattle manure, applied every 3 years+ N50 + 50 kg/ha+P72 kg/ha.

In 2010, the analysis of the canopy structure has shown that the mean recorded values of the presence percentage were of 34% for grasses, 20% for legumes and 46% for other species (*tab. 2*).

The most important changes were found in the plants belonging to the "various" group, which showed significant increases at the same time with the increase in the applied manure rate.

In *Festuca valesiaca* grassland of Ezăreni, a total number of 45 species was recorded, of which six species belonging to grasses, 10 species to fabaceae and 29 species to other species. The species, which were found at high percentages, were *Festuca valesiaca (22%), Agropyron repens (8%), Bromus commutatus (4%), Lotus corniculatus (8%), Medicago falcata (8%), Centaurea jacea (12%), Daucus carota (7%), Achillea setacea (7%)* and *Plantago media (3%).*

Positive changes were observed in the sward composition as the increase of the participation percentage of some valuable fodder species: *Poa pratensis L, Festuca pratensis Huds, Arrhenatherum elatius (L) Presl., Medicago falcata L.*

Table 2

**Influence of fertilization on the canopy structure (%)**

| Fertilization variant | Grasses | | | Legumes | | | Others | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2006 | 2010 | Deviation | 2006 | 2010 | Deviation | 2006 | 2010 | Deviation |
| Unfertilized control | 69 | 40 | -29 | 10 | 14 | +4 | 21 | 46 | +25 |
| 10 t/ha manure every year+$N_{50}$ $P_{36}$ | 76 | 35 | -41 | 13 | 20 | +7 | 11 | 45 | +24 |
| 10 t/ha manure every year+$N_{50}$+$_{50}$ $P_{72}$ | 59 | 31 | -28 | 16 | 17 | +1 | 25 | 44 | +19 |
| 20 t/ha manure every 2 years+$N_{50}$ $P_{36}$ | 70 | 32 | -38 | 11 | 22 | +11 | 19 | 46 | +27 |
| 20 t/ha manure every 2 years+$N_{50}$+$_{50}$ $P_{72}$ | 67 | 34 | -33 | 15 | 21 | +6 | 18 | 45 | +27 |
| 30 t/ha manure every 3 years+$N_{50}$ $P_{36}$ | 62 | 33 | -29 | 11 | 23 | +12 | 27 | 44 | +17 |
| 30 t/ha manure every 3 years+$N_{50}$+$_{50}$ $P_{72}$ | 68 | 32 | -36 | 16 | 23 | +7 | 16 | 45 | +29 |
| 40 t/ha manure every 3 years+$N_{50}$ $P_{36}$ | 71 | 32 | -39 | 12 | 22 | +10 | 17 | 46 | +29 |
| 40 t/ha manure every 3 years+$N_{50}$+$_{50}$ $P_{72}$ | 69 | 33 | -36 | 11 | 21 | +10 | 20 | 46 | +26 |
| **Average** | **68** | **34** | **-34** | **13** | **20** | **+7** | **19** | **46** | **+27** |

The changes induced by the fertilization in the floral structure of the sward also influenced the quality of the fodder. *Table 3* shows the values of crude protein (CP), raw ash (RA) and cellulose. The fertilization of *Festuca valesiaca* grassland is a means of increasing the content in crude protein (CP) up to 1.6 %, as compared with the unfertilized control.

The nitrogen extracted from soil by crops and the coefficient of using nitrogen from fertilizers were influenced by type, rates and combinations of spread fertilizers (*tab. 4*).

Table 3

**Influence of fertilization on the chemical composition**

| Fertilization variant | RA (%) | Cellulose (%) | CP (%) | Yield CP in 2010 (kg ha $^{-1}$) |
|---|---|---|---|---|
| Unfertilized control | 7.8 | 34.3 | 11.7 | 339 |
| 10 t/ha manure every year+$N_{50}$ $P_{36}$ | 9.6 | 33.6 | 12.8 | 499 |
| 10 t/ha manure every year+$N_{50}$+$_{50}$ $P_{72}$ | 8.4 | 33.8 | 13.2 | 554 |
| 20 t/ha manure every 2 years+$N_{50}$ $P_{36}$ | 7.9 | 33.9 | 12.3 | 615 |
| 20 t/ha manure every 2 years+$N_{50}$+$_{50}$ $P_{72}$ | 8.9 | 33.3 | 13.6 | 558 |
| 30 t/ha manure every 3 years+$N_{50}$ $P_{36}$ | 8.4 | 29.8 | 11.9 | 607 |
| 30 t/ha manure every 3 years+$N_{50}$+$_{50}$ $P_{72}$ | 8.9 | 29.5 | 12.5 | 837 |
| 40 t/ha manure every 3 years+$N_{50}$ $P_{36}$ | 9.8 | 33.4 | 12.4 | 645 |
| 40 t/ha manure every 3 years+$N_{50}$+$_{50}$ $P_{72}$ | 9.6 | 33.2 | 12.9 | 851 |

The coefficient of using nitrogen was between 23 and 26% in case of the 10 t/ha manure applied every year, 23 and 44% in case of the 20 t/ha manure applied every 2 years, 43 and 53% in case of the 30 t/ha manure applied every 3 year, 42 and 49% in case of the 40 t/ha manure applied every year**.**

Table 4

**Nitrogen export and use index coefficients of nitrogen in 2010**

| Fertilization variant | Applied N kg ha$^{-1}$ | Exported N | | Coefficient of using applied N (%) |
|---|---|---|---|---|
| | | Total kg ha$^{-1}$ | Dif. to the control kg ha$^{-1}$ | |
| Unfertilized control | 0 | 54 | - | - |
| 10 t/ha manure every year+$N_{50}$ $P_{36}$ | 100 | 80 | 26 | 26 |
| 10 t/ha manure every year+$N_{50}$+$_{50}$ $P_{72}$ | 150 | 89 | 35 | 23 |
| 20 t/ha manure every 2 years+$N_{50}$ $P_{36}$ | 100 | 98 | 44 | 44 |
| 20 t/ha manure every 2 years+$N_{50}$+$_{50}$ $P_{72}$ | 150 | 89 | 35 | 23 |
| 30 t/ha manure every 3 years+$N_{50}$ $P_{36}$ | 100 | 97 | 43 | 43 |
| 30 t/ha manure every 3 years+$N_{50}$+$_{50}$ $P_{72}$ | 150 | 134 | 80 | 53 |
| 40 t/ha manure every 3 years+$N_{50}$ $P_{36}$ | 116 | 103 | 49 | 42 |
| 40 t/ha manure every 3 years+$N_{50}$+$_{50}$ $P_{72}$ | 166 | 136 | 82 | 49 |

## CONCLUSIONS

The obtained DM yields were influenced by climatic conditions, type and level of organic and mineral fertilization. The highest yields were obtained at the fertilization with 40 t/ha cattle manure, applied every 3 years+ N50 + 50 kg/ha+P72 kg/ha.

The obtained results have shown the positive effects of fertilization on productivity, biodiversity and canopy structure of the studied permanent grassland.

The permanent grasslands of *Festuca valesiaca* L. from Romania react very well to the fertilization, which may be an important measure of recovering permanent grasslands.

From the obtained data during 2006-2010 we observed that, considering the climate conditions, the fertilization can induce relatively high productions, related to the applied fertilizers' doses and types.

The nitrogen extracted from soil by crops and the coefficient of using nitrogen from fertilizers were influenced by type, rates and combinations of spread fertilizers.

The management of permanent grasslands, by its way of usage, type and intenseness of fertilization and way of control has a high influence on phytocoenotic biodiversity, on rate of species in the structure of vegetation and dominant species in the canopy.

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