INFLUENCE OF FERTILIZATION UPON FORAGE QUALITY ON A PERMANENT GRASSLAND OF *AGROSTIS CAPILLARIS* L. – *FESTUCA RUBRA* L.

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Abstract

Increasing the productive potential of permanent grasslands and improve the quality of feed produced are issues of great importance, given the necessary assurance of green mass and feed hay for animals. In this purpose has been made in the period 2006-2008, research on a permanent grassland of Agrostis capillaris L. - Festuca rubra L. aiming at the influence of fertilization with mineral fertilizers, cattle manure and vinassa on the quality of obtained forage. Mono-factorials experiences were arranged as randomized blocks in four repetition method and fertilization was done with 15 graduations. In the first year of experience (2007) for fertilization with mineral fertilizers crude protein content of forage increased from 8.95% at control variant to 11.52% at $N_{128}P_{72}$ variant. Referring to cattle manure fertilization percentage of crude protein ranged from 10.38% (20 t cattle manure) to 10.47% (30 t cattle manure), while the administration of vinassa on phosphorus agro-fond it increased from 11.28% at 4 t/ha vinassa+P_{36} variant to 12.36% at variant fertilized with 7 t/ha vinassa+P_{108}. In the next year of experience (2008) crude protein content at variants fertilized with nitrogen was higher compared with previous year (10.48% at N_{64} variant up to 11.78% at $N_{128}P_{72}$ variant) same trend is observed at vinassa fertilization (11.38% at 4 t/ha vinassa+P_{36} variant to 12.94% at fertilization with 7 t/ha vinassa+P_{108}). Crude cellulose content, at variants fertilized with mineral fertilizers, was in 2007 by 25.48% at control variant, reaching 27.60% at variant $N_{128}P_{72}$, while in 2008 increased from 25.92% at control variant to 28.16% at $N_{128}P_{72}$ variant. The same increasing trend was recorded also at fertilization with manure and at application of different rates of vinassa. Finally the percentage of crude protein and crude cellulose recorded growth in the second year of experience, except that the increase of the percentage of crude protein was higher than the percentage increase in crude cellulose. The chemical composition of the forage was influenced by both kinds of fertilizers and used rates.

Key words: quality, forage, *Agrostis capillaris* L., *Festuca rubra* L., fertilization

INTRODUCTION

Permanent grasslands represent an important source of forages due to the cultivated surfaces and the high yields of good quality obtained from them. By a rational use and a rational management of the natural factors the yields of the permanent grasslands may be significantly increased. Fertilization with organic and mineral fertilizers is one of the main means by which we can increase the yield of permanent grasslands and have a strong influence on forage quality by modifications in chemical structure, consumption and digestibility with implications on nutritive and energetic values. The chemical composition of forages is a start point for a scientific concretion of nutrition rates for different categories of animals and is influenced by the greatest extent of the fertilizers assortment and the applied rates. The data regarding the forage content in crude protein and crude cellulose are very interesting and point out the way in which the mineral and organic fertilizers influence the quality of forage. As mineral fertilizers were used nitrogen, phosphorous, potassium and mixtures of them in different rates per hectare and as organic fertilizers, cattle manure and vinassa were used. Vinassa is a product resulted after evaporation of residual waters from bakery yeast factories and has great nitrogen content in comparison

with cattle manure (3–3.2 %) stimulates the growth of grasses and inhibits the growth of legumes and all the plants from other families [1], [3], [10], [11], [15], [16], [17]. In Romania was homologated under the name of "Vinassa-Rompak", in 2003, as an organic fertilizer. Cattle manure enriches soil in micro and macro-elements and also in organic matter which influence the grassland productivity [2], [4], [8], [12], and [13]. Mineral fertilizers based on nitrogen are very favourable for grasses growth and at the same time inhibit the growing of legumes [2], [4], [5], [6], [7], [8], [9], [12], [13], and [14]. The mineral fertilizers on a phosphorous base could increase the yield and the content in dry matter [2], [4], [5], [8], [12], [13]. Potassium has an important role in plants' metabolism, in synthesis of carbon hydrates and chlorophyll, as well as in increasing plants' resistance during winter [2], [4], [5], [8], [12].

MATERIAL AND METHODS

The study was carried out on an *Agrostis capillaris* L. – *Festuca rubra* L. permanent grassland. The land was processed by three passing with a disk-harrow in summer of 2006 and sowing of the mixtures was done at the end of august. The experience was placed on a eutricambosol, which is defined by an A ochric horizon (Ao) or A mollic (Am) followed by a B cambic horizon (Bv) and a C horizon. Soil reaction is weak acid to neutral (pH=6.1), humus content is 3.36%, content in mobile phosphorous had the values between 23-24 ppm and the content in mobile potassium had values ranged 108-110 ppm.

For studying the influence of fertilization on forages' quality the experiment was set up as a random block system in four replications, with 15 variants: V_1–control; V_2–N_{64}; V_3-$N_{64}P_{36}$; V_4-$N_{96}P_{54}$; V_5–$N_{128}P_{72}$; V_6-$N_{64}P_{36}K_{40}$; V_7-$N_{96}P_{54}K_{40}$; V_8–$N_{128}P_{72}K_{40}$; V_9–P_{36}; V_{10}–cattle manure 20 t/ha; V_{11}–cattle manure 30 t/ha; V_{12}–4 t/ha vinassa+P_{36}; V_{13}–5 t/ha vinassa+P_{54}; V_{14}-6 t/ha vinassa+P_{72}; V_{15}-7 t/ha vinassa+P_{108}.

Mineral fertilizers were applied in all years of experiment, those based on phosphorous and potassium in autumn and those based on nitrogen early in the spring. Cattle manure was applied only in the autumn of 2006. Vinassa was yearly applied, early in the spring before start of vegetation.

Harvesting was performed under the form of hay, on each variant, at grasses heading and at budding and blossoming of legumes.

RESULTS AND DISCUSSIONS

In the first year of experience (2007), the content in crude protein of the forage obtained from an *Agrostis capillaris* L. – *Festuca rubra* L. permanent grassland increased from 8.95% at control variant, to 10.34% at N_{64}, 10.86% at $N_{96}P_{54}$ and to 11.52% at $N_{128}P_{72}$.

In 2008 the forages' content in crude protein at the variants fertilized with nitrogen on a phosphorus agro-fond was higher in comparison with year 2007, aspect which could be explain both by the residual effect of the nitrogen fertilizers associated with the annual rate administrated and also by the changes that took place in the composition and structure of the grassy cover. So if at control variant the content in crude protein was 9.12%, at fertilization with N_{64} it increase up to 10.48%, to 11.20% at $N_{96}P_{54}$ fertilization and at variant fertilized with $N_{128}P_{72}$ the percentage was of 11.78% (table 1).

At fertilization with vinassa on a phosphorus agro-fond, the forage content in crude protein increase at the same time with the increasing of the rate of administrated vinassa. So, in year 2007, the content in crude protein increased from 11.28% at variant fertilized with 4 t/ha vinassa+P_{36} to 12.36% at variant fertilized with 7 t/ha vinassa+P_{108} and in the year 2008 increased from 11.38% at 4 t/ha vinassa+P_{36} variant to 12.94% at 7 t/ha vinassa+P_{108} variant (table 1).

Regarding the fertilization with cattle manure (table 1) we observe that in 2007 the values of crude protein were ranged between 10.38% at variant fertilized with 20 t cattle manure and 10.47% at variant fertilized with 30 t cattle manure while in 2008 the values of crude protein were a little bit lower (10.15% at 20 t cattle manure variant and 10.30% at 30 t cattle manure variant). An explanation is given by the fact that cattle manure was

administrated only in the first year of experience (2007 – autumn).

The content in crude cellulose was, in 2007, of 25.28% at control variant, at fertilization with N_{64} the percentage was 25.20%, at $N_{96}P_{54}$ was 27.78% and at variant $N_{128}P_{72}$ the content in crude cellulose was 27.60. In the next year of study (2008) the percentage of crude cellulose started from 25.92% at control variant and increase to 25.56% at variant fertilized with N_{64}, 27.82% at $N_{96}P_{54}$ fertilized variant and to 28.16% at variant $N_{128}P_{72}$ (table 1).

Table 1
The influence of fertilization on crude protein and crude cellulose of the forage from an *Agrostis capillaris* L. – *Festuca rubra* L. permanent grassland

Variant	Crude protein (%)		Crude cellulose (%)	
	2007	2008	2007	2008
Control	8.95	9.12	25.28	25.92
N_{64}	10.34	10.48	25.20	25.56
$N_{64}P_{36}$	10.28	10.55	26.35	26.76
$N_{96}P_{54}$	10.86	11.20	27.78	27.82
$N_{128}P_{72}$	11.52	11.78	27.60	28.16
$N_{64}P_{36}K_{40}$	10.36	10.68	26.10	27.05
$N_{96}P_{54}K_{40}$	10.62	10.91	26.80	27.88
$N_{128}P_{72}K_{40}$	11.41	11.86	27.07	28.37
P_{36}	8.87	9.02	25.65	26.30
Cattle manure 20 t/ha	10.38	10.15	27.65	27.21
Cattle manure 30 t/ha	10.47	10.30	27.76	27.38
4 t/ha Vinassa + P_{36}	11.28	11.38	27.71	27.45
5 t/ha Vinassa + P_{54}	11.42	11.69	27.84	28.16
6 t/ha Vinassa + P_{72}	11.75	12.25	27.90	28.45
7 t/ha Vinassa + P_{108}	12.36	12.94	28.45	28.72

At fertilization with different rates of cattle manure (table 1) could be observed that in the first year, 2007, the percentage of crude protein was higher than the one obtained in the second year, 2008 (27.65% at fertilization with 20 t cattle manure and 27.76% at fertilization with 30 t cattle manure face to 27.21% at 20 t cattle manure fertilization and 27.38% at 30 t cattle manure fertilization).

At fertilization with vinassa on a phosphorus agro-fond, the forage content in crude cellulose increase at the same time with the increasing of the rate of administrated vinassa. In 2007, the content in crude cellulose was ranged between 27.71% at variant fertilized with 4 t/ha vinassa+P_{36} and 28.45% at variant fertilized with 7 t/ha vinassa+P_{108} and in 2008 increased from 27.45% at 4 t/ha vinassa+P_{36} variant to 28.45% at 7 t/ha vinassa+P_{108} variant (table 1).

Fertilization with vinassa on a phosphorus agro-fond induced an increasing of the forage content in phosphorus. In 2008 the values were from 0.22% at variant fertilized with 4 t/ha vinassa+P_{36} up to 0.29% at variant fertilized with 7 t/ha vinassa+P_{108} (table 2).

The content of forage in potassium greater increased at variants fertilized with vinassa on a phosphorus agro-fond (in 2008) from 1.33% at control variant to 1.93% at 4 t/ha vinassa+P_{36} variant, to 2.15% at variant fertilized with 5 t/ha vinassa+P_{54} and to 2.30% at variant fertilized with 7 t/ha vinassa+P_{108} (table 2).

Table 2

The influence of fertilization on chemical composition of the forage from an *Agrostis capillaris* L. – *Festuca rubra* L. permanent grassland

Variant	P (%)		K (%)		Ca (%)		Ca/P	
	2007	2008	2007	2008	2007	2008	2007	2008
Control	0.16	0.17	1.30	1.33	0.49	0.50	3.06	2.94
N_{64}	0.19	0.21	1.24	1.32	0.47	0.49	2.47	2.33
$N_{64}P_{36}$	0.19	0.21	1.31	1.51	0.46	0.44	2.42	2.10
$N_{96}P_{54}$	0.20	0.23	1.37	1.53	0.46	0.43	2.30	1.87
$N_{128}P_{72}$	0.22	0.25	1.35	1.57	0.41	0.43	1.86	1.72
$N_{64}P_{36}K_{40}$	0.18	0.21	1.33	1.54	0.39	0.40	2.16	1.90
$N_{96}P_{54}K_{40}$	0.21	0.23	1.41	1.58	0.38	0.39	1.81	1.70
$N_{128}P_{72}K_{40}$	0.23	0.25	1.40	1.46	0.36	0.38	1.56	1.52
P_{36}	0.17	0.19	1.26	1.38	0.49	0.51	2.88	2.68
Cattle manure 20 t/ha	0.18	0.18	1.72	1.57	0.48	0.44	2.67	2.44
Cattle manure 30 t/ha	0.19	0.18	1.86	1.61	0.51	0.46	2.68	2.55
4 t/ha Vinassa + P_{36}	0.19	0.22	1.62	1.93	0.50	0.48	2.63	2.18
5 t/ha Vinassa + P_{54}	0.20	0.24	1.83	2.15	0.47	0.45	2.35	1.88
6 t/ha Vinassa + P_{72}	0.23	0.27	2.00	2.25	0.42	0.40	1.82	1.48
7 t/ha Vinassa + P_{108}	0.25	0.29	2.05	2.30	0.38	0.35	1.52	1.21

Forages' content in calcium decrease at the same time with the increasing of the nitrogen rates on phosphorus agro-fond from 0.49-0.50% at control variant, to 0.41-0.43% at $N_{128}P_{72}$, and also at the increasing rates of vinassa on a phosphorus agro-fond from 0.47-0.48% at variant 4 t/ha vinassa+P_{36} to 0.35-0.38% at variant fertilized with 7 t/ha vinassa+P_{108} (table 2).

The ratio calcium/phosphorus decreased at the same time with the increasing of the nitrogen rates on a phosphorus agro-fond from 2.94-3.06 at control variant to 1.86-1.72 at $N_{128}P_{72}$ variant (table 2).

At fertilization with vinassa on a phosphorus agro-fond the ratio decreased from 2.18-2.63 at vinassa+P_{36} variant, to 1.88-2.35 at variant fertilized with 5 t/ha vinassa+P_{54} and to 1.21-1.52 at variant fertilized with 7 t/ha vinassa+P_{108} (table 2), the value of 1.21 obtained in year 2008 being under the critical estimated level of 1.50.

CONCLUSIONS

The chemical composition of the forage was influenced by fertilizers type, administrated rates and by the climatic conditions from the research years.

At *Agrostis capillaris* L. – *Festuca rubra* L. permanent grassland the average content in crude protein increased in 2008 from 9.12% at control variant to 11.78% at variant $N_{128}P_{72}$ and to 12.94% at variant fertilized with 7 t/ha vinassa+P_{108}.

The content in crude protein changes less in comparison with the crude protein one being ranged from 25.92% at control variant to 28.36% at $N_{128}P_{72}K_{40}$ and to 28.72% at 7 t/ha vinassa+P_{108} variant.

The forage content in phosphorous increased and the content in calcium decreased at the same time with the increasing rates of nitrogen and phosphorous and with the increasing of the rates of vinassa.

The content in potassium of the forage was strongly influenced by the vinassa rates this increase from 1.33% at control variant to 2.30% at 7 t/ha vinassa+P_{108} variant.

We recommend that at fertilization of an *Agrostis capillaris* L. – *Festuca rubra* L. permanent grassland to use rates of 96-128 kg/ha nitrogen and 54-72 kg/ha phosphorous or 30 t/ha cattle manure.

Vinassa is recommended to be used in rates of 4-5 t/ha on an agro-fond with 36-52 kg/ha phosphorous.

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