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RESEARCH ARTICLE

Effect of fertilization on the chemical composition and quality of cereal grasses fodder with different ripeness

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The influence of fertilization on chemical composition and quality of fodder from cereal grasses has been studied. It was found that the highest indices of crude protein were observed in the variant with *Dactylis glomerata* and *Lolium perenne* 11.2-11.4%, which is 0.9-1.1% more than *Phalaris arundinacea*. When applying phosphorus-potassium fertilizers, the crude protein content increased by 0.1-0.2%, and with complete fertilization - 4.2-4.4%. On average, over the years of research, a grass factor was influential on the yield of 1 ha of dry mass with a share of 36%. Meanwhile, the share of fertilizer factor was 64%.
Keywords: Cereal grasses; Chemical composition; Quality of fodder; Fertilization

Introduction

It is known that under certain conditions, good quality of grass fodder is provided by cereal grasses, which largely depends on soil conditions, composition of grasses, regime of its usage, fertilizers, etc. (Kovtun, 2016). Cereal perennial grasses provide the main part of forage yield, in particular with sufficient moisture under conditions of the Forest-Steppe zone (Panakhyd, 2017; Karbivska, 2020a). Hayfields and pastures are a source of high quality and cheap fodders for livestock. Hay remains one of the main fodders in the diets of animals, as it helps to normal functioning of the stomach and intestines. It is the only roughage containing vitamin D, which regulates mineral metabolism in animal organism (Katsumata, 2018; Christoffers, 2002). The most significant impact on the quality of fodder, in particular on the indices of biochemical composition, has fertilization and usage, as well as the species composition of grasses, which is usually oriented on when preparing rations for feeding highly productive livestock (Kurhak, 2010; Litvinov, 2019). Fertilizer application is one of the most effective measures of haymaking improvement, which caused the targeted changes in growing conditions of meadow plants, which leads to the dominance of valuable species of cereal grasses (Teberdyev, 2015; Karbivska, 2019a). Some researchers reported that the fodder of cereals and legumes contains up to 30% fiber, and its content depends on the botanical composition, fertilizer and mowing time (Mashchak, 2013; Vasile, 2016; Grant, 1982). Fiber in a certain amount is an important factor that normalizes digestion in the rumen of animals, but its excessive content in the diet reduces digestibility and efficiency of nutrient use by animals (Demydas, 2016; Kokovikhin, 2020). Phosphorus-potassium fertilizers, although to a less extent, also affect the amount of protein by increasing relative amount of legumes (Bachinger, 2009; Karbivska, 2020b; Karpenko, 2020). Increasing the doses of nitrogen fertilizer, as shown by studies conducted in the Western region of Ukraine, leads to a decrease in the content of nitrogen free extractives 43.1 - with a single application of nitrogen, while with two- and three times - respectively 38.2 and 38.9% (Yarmoliuk, 2013; Panakhyd, 2014).

Materials and Methods

The soil cover of experimental landplot is represented by sod-podzolic surface gleyed soils on the slope of north-western exposure with a slope of 1-3°. The research was conducted at the stationary land plot of Agrochemistry and Soil Science Department established in 2011 according to the generally accepted methodology. The soil cover of experimental field is represented by sod-podzolic surface-gleyed soil. Repetition - three times, the estimated area of experimental plot - 25 m^2. Zonal and promising species of cereal grasses were sown: *Lolium perenne* - Carpathian, *Lolium perenne* - Kolomyiska, *Lolium pratense* - Menchulska, *Dactylis glomerata* - Stanislavska, *Festuca rubra* - Hoverla, *Phalaris arundinacea* - Smerichka, *Festuca orientalis* - Menchulska. The experiment studied interaction of two factors (Table 1): A - types of grass by degree of ripeness; B - fertilization: without fertilizers, $P_{60}K_{60}$, $N_{90}P_{60}K_{60}$, where mineral fertilizers were applied: ammonium nitrate (34% a.s.); potassium magnesium (29% a.s.); superphosphate (19% a.s.).

Table 1. The scheme of experiment.

FactorA – types of grass by degree of ripeness	Factor B - fertilization
1. *Phleum pratense*	
2. *Lolium perenne*	
3. *Festuca orientalis*	1. without fertilizers
4. *Lolium pratense*	2. $P_{60}K_{60}$
5. *Dactylis glomerata*	3. $N_{90}P_{60}K_{60}$
6. *Festuca rubra*	
7. *Phalaris arundinacea*	

Evaluation of weather conditions during research years was carried out on the basis of meteorological data obtained at Ivano-Frankivsk Regional Center for Hydrometeorology. Weather conditions in 2011 were different from long-term indicators but favorable for formation of agrophytocenoses of cereal grasses. During vegetation period fell 13.1 mm less precipitation than normal while the average daily air temperature decreased by 4.5°C compared to the long-term indices. Year 2012 was characterized by high temperatures with average daily air temperature exceeding long-term norm by +1.5°C and insufficient precipitation amount, when precipitation was 23.7% less than normal. Analyzing weather conditions in 2013 it was noted their difference from average long-term data but they were quite favorable for formation of cereal grass agrophytocenosis. The growth and development of plants was satisfactory. The studies were performed according to the methodology of the Institute of Fodders NAAS (Babych, 1998). Complete zoo-technical analysis of fodders was performed in samples taken during harvesting, air-dried and milled. Dry plant mass was used to determine the content of crude protein, crude fat, crude fiber, crude ash, nitrogen, phosphorus, potassium, digestibility of dry fodder matter in vitro - by infrared spectroscopy, the content of nitrogen-free extractives (BER) - by calculation. The content of fodder units, gross and metabolic energy in fodders was determined by calculation method with usage of coefficients of fodder dry matter digestibility and the content of crude protein, crude fat, crude fiber, BER (DSTU, 2015). Mathematical processing of research results was conducted by methods of variance analysis and variation statistics according to Dospekhov B.A. (1985).

Results and Discussion

Indices of organic substance content in dry mass changed significantly after application of mineral fertilizers at a dose of $N_{90}P_{60}K_{60}$. The content of crude protein in dry mass of different cereal grasses increased by 3.1-4.0% (Table 2).

Table 2. Qualitative composition of cereal grass fodder depending on fertilizers (% on dry mass, average for 2011-2013).

Types of grasses and seeding norms, kg / ha	Fertilization	Crude protein	Albumen	Crude fat	Crude fiber	NFE	Digestibility
1	2	3	4	5	6	7	8
		Early-ripening grasses					
Dactylis glomerata, 16	Without fertilizers (control)	11.2	7.8	3.5	29.5	47.2	57
	$P_{60}K_{60}$	11.3	7.9	3.6	29.6	46.8	58
	$N_{90}P_{60}K_{60}$	15.6	10.8	3.7	30.0	41.9	58
		Middle-ripening grasses					
Festuca orientalis, 26	Without fertilizers (control)	10.8	7.5	3.1	29.8	48.8	55
	$P_{60}K_{60}$	10.9	7.6	3.1	29.6	48.8	55
	$N_{90}P_{60}K_{60}$	15.0	10.4	3.2	30.0	44.1	56
Lolium perenne, 26	Without fertilizers (control)	11.4	7.9	2.8	29.8	48.3	58
	$P_{60}K_{60}$	11.5	8.0	2.8	29.6	48.3	58
	$N_{90}P_{60}K_{60}$	15.6	10.8	2.9	30.0	43.7	59
Bromus inermis, 26	Without fertilizers (control)	10.6	7.3	3.3	29.9	47.9	55
	$P_{60}K_{60}$	10.7	7.4	3.4	29.8	47.7	55
	$N_{90}P_{60}K_{60}$	14.8	10.2	3.4	30.2	43.2	56
Festuca rubra, 18	Without fertilizers (control)	10.4	7.2	2.9	29.4	49.9	56
	$P_{60}K_{60}$	10.6	7.3	2.9	29.5	49.6	56
	$N_{90}P_{60}K_{60}$	14.6	10.1	3.0	30.0	44.9	57
Phalaris arundinacea, 14	Without fertilizers (control)	10.3	7.1	3.4	29.8	48.2	56
	$P_{60}K_{60}$	10.3	7.2	3.4	29.6	48.3	57
	$N_{90}P_{60}K_{60}$	14.5	10.0	3.5	30.0	43.6	57
		Lately-ripening grasses					
Phleum pratense, 14	Without fertilizers (control)	10.7	7.4	2.8	28.8	51.3	58
	$P_{60}K_{60}$	10.9	7.6	2.8	28.6	51.2	58
	$N_{90}P_{60}K_{60}$	14.7	10.2	2.9	29.0	45.9	59
		SSD_{05}, t / ha by factors					
Grass	0,6	0.5	0.1	1.8	2.9	2	
Fertilization	0,7	0.6	0.1	1.7	2.8	2	
		Part of factors, %					
Grass	36	36	57	58	34	41	
Fertilization	64	64	43	42	66	59	

It was found that the highest indicators of crude protein were observed in the variant with *Dactylis glomerata* and *Lolium perenne* 11.2-1.4%, which is 0.9-1.1% more than *Phalaris arundinacea*. When applying phosphorus-potassium fertilizers the crude protein content increased by 0.1-0.2%, and with complete fertilization - 4.2-4.4%. Simultaneously with the higher content of crude protein and albumen with introduction of N_{90}, the content of NFE decreased in the dry mass of cereal grasses from 46.8-51.2 to 41.9-45.9%. When applying mineral fertilizers and especially $N_{90}P_{60}K_{60}$ there was a tendency to increase of crude fat and digestible protein in the dry mass of cereals. When analyzing the content of crude protein in the dry mass of each specie, it was found that the highest content of it on all backgrounds of fertilization had the *Dactylis glomerata* and *Lolium perenne*. Their indices on nitrogen-free backgrounds (variant without fertilizers (control) and fertilizer background $P_{60}K_{60}$) – 10.3-11.5% and on the background of application $N_{90}P_{60}K_{60}$ - 14.5-15.6%. It is 0.9-1.1% more at SSD_{05} 0.6% than accumulated by *Phalaris arundinacea*.

Festuca orientalis, *Bromus inermis*, *Festuca rubra*, *Phleum pratense* in terms of crude protein and albumen content occupied an intermediate position. *Dactylis glomerata* and *Lolium perenne* had the highest protein content on all fertilizer backgrounds and *Phalaris arundinacea* - the lowest. The content of crude fat in the dry mass of studied cereals on different backgrounds of fertilizers ranged from 2.8 to 3.7%. Independently on the background of fertilizers, *Dactylis glomerata* had the highest content and *Lolium perenne* and *Phleum pratense* - the lowest. The content of crude fiber in the dry mass of different cereal grasses ranged from 29.0 to 30.4% and depending on the type of grass did not naturally change. NFE (Nitrogen Free Extractives) indices of dry matter content within different types of cereal grasses were at the level of 41.9-45.9%. The lowest index of NFE content had *Dactylis glomerata*, and the highest - *Phleum pratense*. Digestibility of fodder dry mass ranged from 55 to 59% and did not change naturally with different types of grass. When comparing chemical composition indices of fodder dry mass of cereal grasses with zoo-technical standards for feeding cattle it was found that most of quality indicators mainly met them, but under condition of application $N_{90}P_{60}K_{60}$ with adding nitrogen in small portions. When comparing chemical composition of fodder with the standards (DSTU 4674, 4684, 4685, 4782, 8528), cereal grasses mainly met the requirements of high-quality forage fodders when applying $N_{90}P_{60}K_{60}$. The grass is suitable for the production of hay, haylage, and green fodder of the first class and artificially dried grass fodder of the third class. The content of fodder units in various cereal grasses ranged from 68-72%, metabolic energy - 7.9-8.3 mj/kg (Table 3).

Table 3. Nutrition, energy consumption of dry mass and supply of feeding unit with digestible protein of cereal grasses depending on fertilizers (average for 2011-2013).

Types of grasses and seed sowing norms kg/ha	Fertilization	Content		Provision of fodder unit with digestible protein, g
		Fodder units, %	Metabolism energy, mj / kg	
		Early-ripening grasses		
Dactylis glomerata, 16	Without fertilizers (control)	71	8.1	110
	$P_{60}K_{60}$	71	8.1	110
	$N_{90}P_{60}K_{60}$	72	8.1	152
		Middle-ripening grasses		
Festuca orientalis, 26	Without fertilizers (control)	70	8.0	107
	$P_{60}K_{60}$	70	8.0	107
	$N_{90}P_{60}K_{60}$	71	8.1	149
Lolium perenne, 26	Without fertilizers (control)	72	8.2	109
	$P_{60}K_{60}$	72	8.2	115
	$N_{90}P_{60}K_{60}$	72	8.3	151
Bromus inermis, 26	Without fertilizers (control)	69	8.0	109
	$P_{60}K_{60}$	70	8.1	107
	$N_{90}P_{60}K_{60}$	71	8.2	147
Festuca rubra, 18	Without fertilizers (control)	69	8.1	104
	$P_{60}K_{60}$	70	8.2	106
	$N_{90}P_{60}K_{60}$	71	8.2	142
Phalaris arundinacea, 14	Without fertilizers (control)	68	7.9	104
	$P_{60}K_{60}$	68	7.9	108
	$N_{90}P_{60}K_{60}$	68	7.9	148
		Lately-ripening grasses		
Phleum pratense, 14	Without fertilizers (control)	70	8.1	109
	$P_{60}K_{60}$	70	8.1	107
	$N_{90}P_{60}K_{60}$	71	8.3	144

Slightly lower nutrition parameters by the content in dry matter of feeding units and energy capacity by the content of metabolic energy were characteristic for *Phalaris arundinacea*. Other types of cereal grasses did not naturally differ in these indicators. When comparing the content of feeding units with zoo-technical standards, it was found that their content was mainly within limits of zoo-technical standards. Slightly less than the norm in 1 kg of dry feeding mass was accumulation of metabolic energy (7.9-8.3 mj at the norm of 9-11 mj). Provision of feeding unit with digestible protein of perennial grasses on different fertilizer backgrounds ranged from 104 to 152 g. Mineral nitrogen fertilizers had the greatest influence on the rising of this indicator. In particular, when adding nitrogen at the N_{90} dose to $P_{60}K_{60}$, the provision of feeding unit with digestible protein increased from 107-110 g to 142- 152 g or by 35- 42 g. Among cereal grasses, a slightly better provision of feeding unit with digestible protein was characteristic for *Dactylis glomerata* and *Lolium perenne*, and lower indicators, especially when adding $N_{90}P_{60}K_{60}$, were characteristic for *Phleum pratense* and *Festuca rubra*.

According to our data, noticeable changes in the dry mass of perennial grasses on different fertilizer backgrounds also occurred with the mineral composition (Table 4). The biggest amount of crude ash was accumulated by *Dactylis glomerata* (8.6-8.8%) and the smallest - by *Phleum pratense* and *Festuca rubra* (7.4-7.5%). Application $P_{60}K_{60}$ or $N_{90}P_{60}K_{60}$ increased the content of crude ash in the dry mass to 0.2%. The phosphorus content ranged from 0.25 to 0.35%. There was a slight increase of its content in most types of grass by 0.02-0.04% with SSD_{05} and 0.02% with application of $P_{60}K_{60}$ compared with the control. The biggest amount of phosphorus on all fertilizer backgrounds was accumulated by *Dactylis glomerata*, and the least by *Phleum pratense*. Cereal grasses accumulated potassium in the dry mass within limits of 1.98-2.53%. There was a significant increase of its content in all types of grass, by 0.20-0.36% with application of $P_{60}K_{60}$ compared with the control at SSD_{05} 0.12%. The biggest amount of potassium, as well as phosphorus, was accumulated by *Dactylis glomerata*.

The content of calcium in dry mass of cereal grasses ranged from 0.35 to 0.45%, and magnesium - 0.09 to 0.16%. Among the variants with fertilizing, calcium in all types of grasses, and magnesium in most species, except for Bromus inermis were accumulated best of all when applying $N_{90}P_{60}K_{60}$. Among the species of grass, a slightly bigger amount of calcium in the dry mass was accumulated by *Bromus inermis* and *Phleum pratense*, and magnesium - by *Lolium perenne* and *Dactylis glomerata*. Together with changes in mineral composition of fodders from perennial grasses, in our studies were also observed slight changes in important for cattle feeding ratios of mineral elements. Thus, the ratio of potassium to the sum of calcium and magnesium, which ranged from 2.9 to 5.0in different species, was the highest at the background of $P_{60}K_{60}$, and the lowest - $N_{90}P_{60}K_{60}$. The ratio of calcium to phosphorus ranged from 1.1 to 1.7. Among the types of grasses it was slightly larger in *Phleum pratense*, and among fertilizers - in the variant with application of $N_{90}P_{60}K_{60}$.

However, it should be noted that both the ratio of K: (Ca + Mg) and the ratio of Ca: P did not exceed zoo-technical standards for cattle. This indicates that the green mass of perennial cereal grasses, as well as raw materials for the production of grass fodder, is quite suitable for feeding cattle.

Table 4. The content of crude ash and macronutrients in the dry mass of cereals and their ratio depending on fertilizer (%, average for 2011-2013).

Types of grasses	Fertilization	Crude ash	P	K	Ca	Mg	K: (Ca+Mg)	Ca : P
Early-ripening grasses								
Dactylis glomerata, 16	Without fertilizers (control)	8.6	0.34	2.25	0.38	0.14	4.3	1.1
	$P_{60}K_{60}$	8.7	0.37	2.53	0.39	0.13	4.9	1.1
	$N_{90}P_{60}K_{60}$	8.8	0.35	2.38	0.42	0.16	4.1	1.3
Middle-ripening grasses								
Festuca orientalis, 26	Without fertilizers (control)	7.5	0.28	2.15	0.39	0.12	4.2	1.4
	$P_{60}K_{60}$	7.6	0.30	2.24	0.37	0.11	4.7	1.2
	$N_{90}P_{60}K_{60}$	7.7	0.29	2.13	0.40	0.14	3.9	1.4
Lolium perenne, 26	Without fertilizers (control)	7.7	0.30	2.11	0.36	0.14	4.2	1.2
	$P_{60}K_{60}$	7.8	0.32	2.24	0.35	0.14	4.6	1.1
	$N_{90}P_{60}K_{60}$	7.8	0.30	2.13	0.39	0.16	3.9	1.3
Bromus inermis, 26	Without fertilizers (control)	8.3	0.33	2.12	0.41	0.12	4.0	1.2
	$P_{60}K_{60}$	8.4	0.34	2.43	0.41	0.11	4.7	1.2
	$N_{90}P_{60}K_{60}$	8.4	0.33	2.09	0.44	0.09	3.9	1.3
Festuca rubra, 18	Without fertilizers (control)	7.4	0.26	2.09	0.35	0.13	4.4	1.3
	$P_{60}K_{60}$	7.4	0.30	2.21	0.34	0.12	4.8	1.1
	$N_{90}P_{60}K_{60}$	7.5	0.27	2.14	0.38	0.15	4.0	1.4
Phalaris arundinacea, 14	Without fertilizers (control)	8.3	0.27	2.14	0.36	0.12	4.5	1.3
	$P_{60}K_{60}$	8.4	0.29	2.34	0.35	0.12	5.0	1.2
	$N_{90}P_{60}K_{60}$	8.4	0.26	2.10	0.39	0.15	2.9	1.5
Lately-ripening grasses								
Phleum pratense, 14	Without fertilizers (control)	7.4	0.25	1.98	0.40	0.11	3.9	1.6
	$P_{60}K_{60}$	7.5	0.28	2.34	0.41	0.11	4.5	1.5
	$N_{90}P_{60}K_{60}$	7.5	0.27	2.15	0.45	0.14	3.6	1.7
Zoo-technical norm			0.2-0.35	1.0-3.0	0.3-0.6	0.12-0.26		0.7-2.5
SSD_{05}		0.4	0.02	0.12	0.03	0.01		

Conclusion

The main factor influencing the content of organic matter in the fodder of cereal grasses is fertilization with nitrogen fertilizers. Application of mineral fertilizers in a dose of $N_{90}P_{60}K_{60}$ with even ripening allows receiving a fodder with the content of crude protein of 15.6%, crude albumen - 10.8%, crude fat - 2.9%, crude fiber - 30.0%, NFE - 43.7% in the variant with *Lolium perenne*.

References

Babych A. O. (1998). Methods of conducting experiments in fodder production and animal feeding. Vinnytsia.

Bachinger J., Reining E. (2009). An empirical statistical model for predicting the yield of herbage from legume-grass swards within organic crop rotations based on cumulative water balances. Grass and Forage Science, 64, 144-159.

Christoffers M. J., Berg M. L., Messersmith C. G. (2002). An isoleucine to leucine mutation in acetyl-CoA carboxylase confers herbicide resistance in wild oat. Genome, 45 (6), 1049-1056.

Demydas H. I., Demtsiura Yu. V. (2016). Influence of fertilizer level and sowing method on organic matter contentin green mass of mixtures of alfalfa and cereals. Silske hospodarstvo ta lisivnytstvo, 3, 76-83.

Dospekhov B. A. (1985). The methodology of field experiment (with the basics of statistical processing of research results). - 5th revised and enlarged edition. Moscow. Agropromizdat.

Feed for farm animals. Methods for determining energy consumption and nutritional value. (2017). DSTU 8066:2015. Kyiv. (National standard of Ukraine).

Grant W. F. (1982). Cytogenetic Studies of Agricultural Chemicals in Plants. In: Fleck R.A., Hollaender A. (eds) Genetic Toxicology. Basic Life Sciences, vol 6. Springer, Boston, MA.

Karbivska U. M., Kurgak V. G., Kaminskyi V. F., Butenko A. O., Davydenko G. A., Viunenko O. B., Vyhaniailo S. M., Khomenko S. V. (2020). Economic and Energy Efficiency of Forming and Using Legume-Cereal Grass Stands Depending on Fertilizers. Ukrainian Journal of Ecology, 10(2), 284-288.

Karbivska U. M., Butenko A. O., Masyk I. M., Kozhushko N. S., Dubovyk V. I., Kriuchko L. V., Onopriienko V. P., Onopriienko I. M., Khomenko L. M. (2019). Influence of Agrotechnical Measures on the Quality of Feed of Legume-Grass Mixtures. Ukrainian Journal of Ecology, 9(4), 547-551.

Karbivska U., Kurgak V., Gamayunova V., Butenko A., Malynka L., Kovalenko I., Onychko V., Masyk I., Chyrva A., Zakharchenko E., Tkachenko O., Pshychenko O. (2020). Productivity and Quality of Diverse Ripe Pasture Grass Fodder Depends on the Method of Soil Cultivation. Acta Agrobotanica, 73(3), 1-11.

Karpenko O. Yu., Rozhko V. M., Butenko A. O., Samkova O. P., Lychuk A. I., Matviienko I. S., Masyk I. M., Sobran I. V., Kankash H. D. (2020). Influence of agricultural systems and measures of basic tillage on the number of microorganisms in the soil under winter wheat crops of the Right-bank forest-steppe of Ukraine. Ukrainian Journal of Ecology, 10(5), 76-80.

Katsumata M., Kobayashi H., Ashihara A., Ishida A. (2018). Effects of dietary lysine levels and lighting conditions on intramuscular fat accumulation in growing pigs. Animal Science Journal, 89(7), 988–993.

Kokovikhin S. V., Kovalenko V. P., Slepchenko A. A., Tonkha O. L., Kovalenko N. O., Butenko A. O., Ushkarenko V. O. (2020). Regularities of sowing alfalfa productivity formation while using different types of nitrogen fertilizers in cultivation technology. Modern Phytomorphology, 14, 35-39.

Kovtun K. P., Veklenko Y. A., Kopayhorodska H. O. (2016). Chemical composition and quality of feed of the degradated old grass stands of the meadow lands under different methods of their improvement in the right-bank Forest-Steppe, Feeds and Feed Production, 82, 204–209.

Kurgak V. G. (2010). Meadow agrophytocenoses. Kyiv. DIA.

Litvinov D. V., Butenko A. O., Onychko V. I., Onychko T. O., Malynka L.V., Masyk, I.M., Bondarieva, L.M., Ihnatieva, O.L. (2019). Parameters of biological circulation of phytomass and nutritional elements in crop rotations. Ukrainian Journal of Ecology, 9(3), 92-98.

Mashchak Ya. I., Rudavska N. M. (2013). Quality and nutritional value of feed mixtures seeded with hay use. Rudavskii Foothill and mountain agriculture and livestock, 55(2), 81-85.

Panakhyd H. Ia., Konyk H. S. (2017). Basic indicators of forage quality of leguminous and cereal sown grass. Forages and forage production, 83, 145-149.

Panakhyd H. Ia., Kotiash U. O., Konyk H. S., Yarmoliuk M. T. (2014). Effect durable meadow agrophytocenoses their feeding performance. Foothill and mountain agriculture and livestock, 56(2), 56-62.

Teberdyev D. M., Rodyonova A. V. (2015). Efficacy of fertilizing a long-term hayfield. Fodder production, Moscow, 10, 3-7.

Vasile, A.J., Andreea, I.R., Popescu, G.H., Elvira, N., Marian, Z. (2016). Implications of agricultural bioenergy crop production and prices in changing the land use paradigm - The case of Romania. Land Use Policy Vol. 50. P. 399-407.

Yarmoliuk M. T., Sedilo H. M., Konyk H. S., Dziabiak H. M. (2013). Agroecobiological bases of creation and use of meadow phytocenoses. Lviv: SPOLOM.

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