FORAGE VALUE OF THE SPECIES *GALEGA ORIENTALIS* LAM. UNDER THE CONDITIONS OF THE REPUBLIC OF MOLDOVA

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Abstract. *The results of the research on biological features, productivity, chemical composition and forage value Galega orientalis, variety Speranţa are presented in this paper. It has been established that Galega orientalis, in the 3rd-4th years of vegetation has an accelerated growth and development rate. In May the yield reaches 45.0-58.5 t/ha of natural forage with a high degree of foliage (54-56%). During the growing season, Galega orientalis was harvested three times. Its productivity reached 79.8 t/ha green mass, 15.1 t/ha nutritive units provided with 2176 kg/ha digestible protein. The green mass of Galega orientalis used for preparation of hay, leaves remain on the stem, which helps ensure higher forage value. 100 kg of hay contain 71-74 nutritive units, 750-793 MJ/kg metabolizable energy for cattle and 9.16-12.2 kg digestible protein.*

Key words*: Galega orientalis*, variety Speranţa, biological features, productivity, chemical composition, forage value.

INTRODUCTION

One of the most important tasks ahead for agriculture worldwide is to secure sufficient food for a growing population without further straining our environmental resources. The challenge is to produce more food with less external input. The legume family, *Fabaceae* Lindl., is one of the largest in the plant kingdom. Almost all species in the family form symbioses with bacteria in the family *Rhizobiaceae*, leading to biological nitrogen fixation. This capacity for nitrogen fixation has several impacts. It means that the plants can grow in nitrogen deficient soils and at the same time produce protein-rich plant material. This high protein content and production, which is intrinsic to legumes, determines much of the role of legumes not only in general human and animal nutrition, but also their suitability for novel feed uses and uses in the non-food sector. Biological nitrogen fixation is a characteristic of pioneer plants and so gives rise to another potential use of legumes in the bioremediation or colonization of soils otherwise unsuited for agriculture.

Forage legumes have been suggested as important components of low input, sustainable systems for livestock production.

In the context of acute shortage protein substances in forages, which influences negatively the revitalization of the livestock sector of the Republic of Moldova, the diversification of forage production by mobilization, acclimatization and implementation of new crops both from local flora and other floristic regions is necessary.

Galega orientalis Lam., native to Caucasus, is a promising species studied and used in several countries [BALEZENTIENE, 2008; DARMOHRAY, 2009; NOMMSALU, 1994; PIKUN, 2011], including the Republic of Moldova [ŢÎŢEI AND TELEUŢĂ, 2011; 2012].

Fodder galega, eastern galega, *Galega orientalis* Lam. is herbaceous perennial, forms a solid shrub of 10 to 18 leafy stems, 0.8-2.0 m. Alternate, odd-pinnate 15-30 cm long leaves have a good feature to stay unscrambled during drying hay with pinnate. Tap root system composed of combined lateral rhizomes. At a depth of 7 cm the main roots produce 2-18 lateral

offspring – rhizomes. They grow horizontally over 30 cm in length, and form buds, which are sprouting shoots. The main mass of roots is located at a depth of 50-80 cm, at a maximum of 2 m. From 2 to 4 x 1.0 to 4.5 cm nodules formed on lateral roots. Root nodules contain endophytic *Rhizobia galegae* which perform nitrogen fixation and thus foster its accumulation in rhizosphere and increasing soil fertility [BALEZENTIENE, 2005]. Tap-rooted and rhizomatous with overwintered rhizomes emerging in spring to initiate new shoots which eventually take root and become independent plants. Mellifluous inflorescences comprised of bright lilac clusters with 25-70 florets. Pods are 2 to 4 cm long, containing 5 to 8 kidney-shaped seeds, yellowish green in colour but later light brown. Seed size is 2.5-4.0 mm long, l.7 – 2.0 mm wide. 2n = 2x = 16.

The objective of this research was to evaluate biological features, productivity, chemical composition and forage value *Galega orientalis*, variety Speranţa.

MATERIALS AND METHODS

The variety Speranţa of *Galega orientalis*, created with in the Botanical Garden (Institute) of the Academy of Sciences of Moldova, registered in the Catalogue of plant varieties of the Republic of Moldova in 1998, served as object of study.

The experiments were performed in 2010, using previously scarified and bacterized seeds. The seeds were sown at a depth of 1.5-2.0 cm, with soil compaction before and after sowing. The area of the plot was 10 m^2. Number of repetitions - 4. The scientific researches on growth and development, productivity and nutritional value of plants were carried out according to the methodical indications [NOVOSELOV ET AL., 1983; PETUKHOV ET AL., 1989].

RESULTS AND DISCUSSIONS

We could mention that, in the conditions of the Republic of Moldova, *Galega orientalis* seeds require more humidity and higher temperatures of the seedbed in order to germinate in soil in comparison with alfalfa. Seedlings appeared on the soil surface after 17-20 days after sowing. During the following 40-50 days, the root system was developing intensively and the rosette was formed. In the first year, the growth and development of the aerial part was very slow, the height of shoots in the middle of July did not exceed 50 cm and by the end of August about 1/3 of plants reached the flowering stage [TELEUȚĂ AND ȚÎȚEI, 2011].

Slow growth and development of plants in the first year of vegetation, their acceleration in the second year and the full development of plants in the third year of vegetation are specific characteristics of *Galega orientalis* [PIKUN, 2011; SAGIROVA, 2009; UTEUSH, 1990].

Analyzing the results of biological characteristics of growth and development during the 3rd-4th years of vegetation it was established that the plants started growing after wintering in the middle of March. Due to atmospheric precipitation during winter and spring, and the normal moisture content of soil, plants' revival was uniform. From dormant buds situated above the collar, generative shoots developed in early spring and, from the big buds formed at the bottom of the root collar, new underground shoots (suckers) developed, having a hard hood on the tip due to which, shoots penetrate the ground and extend, forming a circle around the mother plant. Subsequently, the secondary root system developed and nodules that associate with nitrogen-fixing bacteria formed on it. Initially, the rosette with leaves developed and, after 10-12 days, shoots started forming. Growth and development of shoots accelerated during April. In the first ten days of May, the flower bud formation of *Galega orientalis* plants started. Plants were harvested for the first mowing in the phase of flower bud formation and a yield of

4.50 kg/m^2 green mass was obtained (Table 1). It was found that the fodder harvested during this period was characterized by a high content of leaves, but a low content of dry matter.

During the next 14 days, the shoots of *Galega orientalis* plants grew both in height (150-160 cm) and in diameter (0.5-0.7 cm), accumulation of dry matter was increasing, the plants were in the early flowering phase. The fodder was harvested when the plants started flowering and a productivity of 5.85 kg/m^2 green mass or 1.02 kg/m^2 dry matter was obtained.

Table1

Some biological peculiarities and productivity of the species *Galega orientalis*

Indices	Plant height, *cm*	Yield green mass, *kg/m^2*	Yield dry matter, *kg/m^2*	Content of leaves in the fodder, *%*
First mowing (bud formation)	114	4.50	0.67	56
First mowing (early flowering)	155	5.85	1.02	54
Second mowing	109	2.00	0.58	63
Third mowing	84	1.48	0.37	66

Regeneration and growth rate of the species *Galega orientalis* after the first mowing was slower as compared with alfalfa. *Galega orientalis* regenerated from axillary buds situated on the remaining stem above the ground after harvest and partly from underground buds on the rhizomes, which usually form thinner shoots. It was established that during the 50 days, *Galega orientalis* plants developed shoots that grew about 109 cm tall. After harvesting the fodder at the end of July, 2.00 kg/m^2 green mass or 0.58 kg/m^2 dry matter were obtained. The natural fodder was richer in leaves and dry matter at the second mowing.

After the second mowing, the revival of plant was quite slow and uneven because of adverse weather conditions (soil and air moisture deficit and high temperatures above 30 ºC). The start of growth and development was observed at middle of August and, until the end of vegetation, the formed shoots were semi-erect, thin, with a lot of leaves (66%) and over 80-87 cm long. The harvested green mass at the third mowing was formed only from shoots developed from lateral buds, so the yield decreased in comparison with the two previous harvests, while the quality of green mass was higher. The fodder yield at the third mowing reached 1.48 kg/m^2 green mass or 0.37 kg/m^2 dry matter.

The annual fodder productivity reached 79.8 t/ha green mass or 16.2 t/ha dry matter.

In practice of animal husbandry it is widely recognized that, of all external environmental factors, nutrition affects the most the animal organism, it promotes growth and development, resistance to diseases and influences the reproductive function of animals. In terms of quantity and quality, food largely determines the cost of the products and animal productivity. In order to maintain vital functions and give different productions, animals need continually an exogenous intake of nutrients they receive from feed. Biochemical composition of the dry matter from vegetal fodder influences the digestibility and nutritional value, animal health and productivity. Proteins are key nutrients in the diet of animals both in terms of quantity and quality. Cellular protein components of animal body are in constant renewal, thus ensuring the optimal functioning of all physiological processes.

Analyzing the biochemical composition of the dry matter from natural fodder, Table 2, we found that the raw protein content changed depending on the harvesting period, reaching values of 15.42-19.31%. The fodder harvested at the first mowing, in the phase of flower bud period, and that harvested at the third mowing were distinguished by high raw protein content and, at the same time, by low cellulose content.

The vegetable fats from fodder are the main source of energy for animals because they are necessary for the organism in order to ensure the normal development of vital processes and contribute to the accumulation of fat in milk. It was found that the fodder of *Galega orientalis* had a high fat content. At the second mowing it reached 3.82% fat in dry matter. A lower amount of fat (2.73%) was observed at the first mowing, when *Galega orientalis* plants early flowering period.

Table 2

Forage value of the natural forage of *Galega orientalis*

Indices	First mowing (bud formation)	First mowing (early flowering)	Second mowing	Third mowing
Biochemical composition dry matter:				
raw protein, *%*	17.80	15.42	15.42	19.31
raw fats, *%.*	3.55	2.73	3.82	3.18
raw cellulose, *%.*	30.50	36.95	34.52	33.69
nitrogen free extractive substances,*%*	39.46	36.39	37.71	35.58
mineral substances, *%*	8.69	8.51	8.53	8.24
1 kg of natural forage contains:				
dry matter, g	148.4	178.3	291.8	248.4
nutritive units	0.14	0.15	0.27	0.23
metabolizable energy for cattle, MJ/kg	1.55	1.70	2.80	2.44
digestible protein, g/nutritive unit	145.9	138.2	129.2	163.6

We may mention that the dry matter from the natural fodder of *Galega orientalis* contained 35.38-39.47% nitrogen free extractive substances.

The presence of minerals in animal feed is indispensable for growth and health, because they are essential components of all tissues and organs that maintain a constant osmotic pressure, participate in regulation of acid-base balance, activate a number of enzymes, moderate neuromuscular activities and prevent the emergence and development of animal diseases. The natural fodder of *Galega orientalis* is distinguished by a moderate content of minerals (8.24-8.69%), their quantity insignificantly decreases in the fodder harvested at the end of vegetation.

It was found that the natural fodder of *Galega orientalis*, at the first mowing, had a very low content of dry matter, which had a negative impact on the nutritional value, so 1 kg natural fodder had 0.14-0.15 nutritive units and 1.55-170 MJ metabolizable energy for cattle and at the second harvest it reached the highest level, namely 0.27 nutritive units and 2.80 MJ. The digestible protein content met the zootechnical standards and constituted 129.2-163.6 g/nutritive unit.

So, the plants were harvested for the first mowing in the flower bud formation period and we obtained 6.3 t/ha nutritive units with 919 kg/ha digestible protein and in the period when plants started flowering – 8.8 t/ha nutritive units with 1216 kg/ha digestible protein; at the second harvest – 5.4 t/ha nutritive units with 697 kg/ha digestible protein, at the third harvest – 3.4 t/ha nutritive units with 560 kg/ha digestible protein, respectively. *Galega orientalis* has a productive potential of 15.1 t/ha nutritive units provided with 2176 kg/ha digestible protein.

Hay for ruminants is one of the main roughages, which is due to its physiological role in the processes of digestion of ruminants, providing half of the necessary digestible protein, sugars, minerals and carotene and is a source of coarse fibre needed for normal rumen digestion, vitamin D and regulates the mineral metabolism in the body. Forage legume hay is the most recommended for maintaining a healthy digestive system, which in turn improves overall health. A high-fibre diet will help lower the incidence of soft stools and intestinal gas. Its fresh aroma encourages consumption.

The nutrient composition of legume hay varies depending on many factors such as species, maturity, fertilization and soil fertility, growing environment and harvesting conditions. The fresh mass of *Galega orientalis* used for preparation of hay. When preparing hay, leaves remain on the stem, which helps ensure higher forage value.

Analyzing the biochemical composition of dry matter from the hay of *Galega orientalis* (Table 3), we may mention that when green mass is drying, the raw protein and fat content is reducing and the cellulose and mineral content is increasing. The biochemical composition of the dry matter from the hay of *Galega orientalis*: 14.35- 17.83 % protein, 1.46-2.38 % fats, 32.15-37.58 % cellulose, 36.86-41.65 % nitrogen free extractive substances and 8.48-10.58 % mineral substances.

Table 3

Nutritional value of hay of *Galega orientalis*

Indices	First mowing (early flowering)	Second harvest	Third harvest
Biochemical composition dry matter:			
raw protein, *%*.	14.60	14.35	17.83
raw fats, *%*	1.46	1.57	2.38
raw cellulose, *%*	37.58	32.15	34.39
nitrogen free extractive substances,*%*	36.86	41.65	36.92
mineral substances, *%*	9.50	10.58	8.48
1 kg hay contains:			
nutritive units	0.71	0.73	0.74
metabolizable energy for cattle, MJ/kg	7.50	7.70	7.93
digestible protein, g/ nutritive unit	132.2	125.5	164.6

The content of organic substances and their biochemical composition influence the nutritional and energy value of the hay of *Galega orientalis*. So, 100 kg of hay obtained at the first mowing contain 71 nutritive units, 750 MJ/kg metabolizable energy and 9.39 kg digestible protein, and – at the second mowing – 73 nutritive units, 770 MJ/kg metabolizable energy and 9.16 kg digestible protein. The hay obtained at the third mowing is also characterised by a rather high quality – 74 nutritive units, 793 MJ/kg metabolizable energy and 12.2 kg digestible protein.

CONCLUSION

The variety Speranţa of *Galega orientalis* is characterised by a uniform revival, rapid growth and development that allow to start the first harvest in early May, the yield reaches 45.0 t/ha and when plants start flowering – 58.5 t/ha. *Galega orientalis* plants can be harvested earlier than alfalfa, a fact which will help ensure a regular provision with natural forage.

During the growing season, *Galega orientalis* was harvested three times. Its productivity reached 79.8 t/ha green mass, 15.1 t/ha nutritive units provided with 2176 kg/ha digestible protein.

The green mass of *Galega orientalis* used for preparation of hay, leaves remain on the stem, which helps ensure higher forage value. 100 kg of hay contain 71-74 nutritive units, 750-793 MJ/kg metabolizable energy and 9.16-12.2 kg digestible protein.

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