SOME AGRO BIOLOGICAL FEATURES AND HAY QUALITY OF FODDER GALEGA, GALEGA ORIENTALIS

ŢÎŢEI V. *, **,***, COŞMAN S. **

*“Alexandru Ciubotaru” National Botanical Garden (Institute), Republic of Moldova, MD 2002 Chişinău, 18 Pădurii str.  
**Scientific and Practical Institute of Biotechnologies in Animal Husbandry and Veterinary Medicine, Maximovca, MD 6525, Republic of Moldova.  
***Corresponding author email: vic.titei@gmail.com

Abstract  
The results of the evaluation of the biological features, growth and development rates, the productivity, the biochemical composition, the metabolizable energy and relative feed value of the hay made from the non-native perennial leguminous species Galega orientalis, cv. Speranţa, maintained in monoculture in the National Botanical Garden (Institute) from Moldova, are presented in this article. The productivity of cv. Speranţa of fodder galeg in the 7th growing season reached 101.5 t/ha green mass or 20.3 t/ha dry matter. The hay quality varied significantly in dependence of the harvest time and contained 153-212 g/kg raw protein, 13-24 g/kg raw fats, 103-128 g/kg ash, 458-584 g/kg NDF, 315-386 g/kg ADF, 48-60 g/kg ADL, 62.7-72.9 % DMD, 57.4-67.7% OMD, 8.81-9.66 MJ/kg ME and RFV 95-131. The cultivation of the cv. Speranţa of Galega orientalis would help solving acute problems related to the supply of qualitative hay to feed domestic animals, increasing the amount of nitrogen and humus in soil.

Keywords: agro biological features, Galega orientalis, hay quality, perennial forage legumes, cv. Speranţa

INTRODUCTION

In the context of climate change and global population growth, combined with a decreasing availability of land and fossil energy resources, leguminous plants (Fabaceae Lindl.) are one of the most economically important plant families, commonly used in the production of food for humans and livestock, as well as in industrial products. Leguminous plants play an important role in forming and maintaining phytocoenoses, increasing the amount of humus in soil, but also increases forage productivity and the intake of the ration, hence, gives better performance in terms of livestock production.

Because feeding costs can account for over 50% of the cost of livestock production, knowing forage quality and the needs of animals can have a significant impact on profitability. Hay is a very popular form of forage preservation and valuable feed for farm animals, a rich source of protein, vitamins and minerals, both in winter and
throughout the year, especially for the young animals, pregnant females and breeding males. Feeding high quality hay can also reduce the level of grain supplementation needed during winter. Selecting the right species is the fundamental first step in forage management. The most commonly used forage legume for hay production is alfalfa. Although alfalfa is a perennial, the plantations usually persist for only three to five years, and the quality of hay is constrained by the considerable amount of leaves that fall from the stems while drying the plants.

The diversification of legume forage production has to be achieved by mobilization, acclimatization and implementation of new crops from other floristic regions.

*The Plant List* includes 56 scientific plant names of species rank for the genus *Galega*, family *Fabaceae*, native to the Balkans, the Caucasus and Asia Minor. Five of them are accepted species names. Among economically important species, there are goat’s rue – *Galega officinalis* L., occurs in the local flora of Moldova and Romania, and fodder galega – *Galega orientalis* Lam., native to the Caucasus, studied and used in several countries (Raig, 1982; Radenovic, 1999; Balezentien, 2008; ZHI, 2008; Pikun, 2011; Darmohray *et al.*, 2017; MERIPÕLD *et al.*, 2017), including the Republic of Moldova (Ţîţei and Teleuţă, 2012).

Fodder galega or eastern galega, *Galega orientalis* Lam. Is an herbaceous perennial (may persist for 15 years), forms a solid shrub of 10 to 18 leafy stems, 0.8-2.0 m. Alternate, odd-pinnate 15-30 cm long leaves, which have a good feature to stay unscrambled during drying the production of hay. 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 form on lateral roots. Root nodules contain endophytic *Rhizobia galegae*. 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, 1.7 – 2.0 mm wide. 2n = 2x = 16. It can grow in all types of soil except in the waterlogged ones. Therefore, *Galega orientalis* L. have high herb productivity and a capacity to fix atmospheric nitrogen in a range of 200-453 kg/ha/year (NÖMMSALU *et al.*, 1996). In Russia, it has been cultivated since the 1920s. It can be used to feed domestic animals as green forage, hay, dried material, silage and protein concentrate, but also as energy biomass for biogas production (Raig, 1982; Uteush, 1990; Pikun, 2011; Meripõld *et al.*, 2017).
Galega herb contains highly active biological compounds with hypoglycemic effect, contributes to the normalization of plasma homeostatic parameters and can improve the functional state of the kidneys. (Aizman et al., 2019).

**MATERIAL AND METHOD**

The variety *Speranța* of fodder galega, *Galega orientalis*, created at the “Alexandru Ciubotaru” National Botanical Garden (Institute) and registered in the Catalogue of Plant Varieties of the Republic of Moldova, grown in monoculture on the experimental land of NBGI, Chișinău, latitude 46°58′25.7″ and longitude N28°52′57.8″E, served as subject of the research. The experimental design was a randomised complete block design with four replications. The scientific research on growth, development and productivity of the plants was carried out according to the methodical indications [NOVOSIOLOV et al., 1983]. The green mass was harvested manually; the plants were cut for the first time in the budding-flowering stage. The green mass productivity was determined by weighing the yield obtained from a harvested area of 10 m². The leaves/stems ratio was determined by separating the leaves, buds and flowers from the stem, weighing them separately and establishing the ratios for these quantities (leaves/stems).

The green mass was harvested for the first time by cutting the plants in full flowering stage (18.05.2016), the second time – in early flowering stage (30.06.2016) and the third time – in the budding period (19.09.2016). The hay- harvested mass was dried directly in the field. The dry matter content was detected by drying samples up to constant weight at 105 °C; crude protein – by Kjeldahl method; crude fat – by Soxhlet method; crude cellulose – by Van Soest method; ash – in muffle furnace at 550 °C, carotene applying the standard methods in the Laboratory of Nutrition and Feed Technology of the Institute of Biotechnology in Animal Husbandry and Veterinary Medicine. The content of neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL), dry matter digestibility (DMD) and organic matter digestibility (OMD) were evaluated using the near infrared spectroscopy (NIRS) technique PERTEN DA 7200 at the Research-Development Institute for Grassland Brasov, Romania. Cellulose (CEL), Hemicellulose (HC), Metabolizable energy (ME) and Relative feed value (RFV) were calculated according to standard procedures.
RESULTS AND DISCUSSION

While conducting prior research, we found that, under the conditions of the Republic of Moldova, the seeds of *Galega orientalis* require more humidity and higher temperatures of the seedbed in order to germinate in soil, in comparison with the traditional leguminous fodder crop alfalfa (*Medicago sativa*). 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 (Teleuţă and Țîței, 2012, Teleuţă et al., 2015).

The slow growth and development of plants in the first year, their acceleration in the second year and the full development of plants in the third year are specific characteristics of *Galega orientalis* (Pikun, 2011; Uteush, 1990).

Analysing the agro-biological features of fodder galega, *Galega orientalis* in the 7th growing season (table 1), it was established that the revival of plants from dormant buds situated above the collar was uniform, generative shoots developed in early April, they were characterised by faster grow and development rates, the flower bud formation of plants started at the beginning of May. During the next 12 days, it was found that the *Galega orientalis* plants reached 155 cm in height and 4.3-6.1 mm in diameter. The yield at the first harvest reached 6.11 kg/m² green mass or 1.10 kg/m² dry matter, characterized by a moderate content of leaves.

After being mowed, the *Galega orientalis* plants regenerated from axillary buds situated on the remaining stem above the ground after harvest and partially from new underground buds on the rhizomes, underground stolons, which usually form thinner shoots as compared with those formed the previous spring. Due to the high amount of atmospheric precipitation, the optimal air moisture and temperatures during late May and June, and the normal moisture content of soil, the revival of plants was fast. It was established that during 40 days, *Galega orientalis* plants developed shoots that grew about 80-85 cm tall. After mowing the plants at the end of June, 2.78 kg/m² green mass or 0.64 kg/m² dry matter were obtained. The mass obtained at the second harvest was richer in leaves (71 %).

The unfavourable meteorological conditions, the lack of rainfall and the very high air temperatures (35-38 ºC) during the second half of the summer affected the regeneration and development of *Galega orientalis* plants. A better growth and development was observed after the rain that fell at the end of August, the formed shoots
were semi-erect, thin, with a lot of leaves (74%) and over 45-57 cm long. The yield at the third harvest decreased in comparison with the two previous harvests, and reached 1.26 kg/m² green mass or 0.29 kg/m² dry matter. The productivity of *Galega orientalis* in the 7th growing season reached 101.5 t/ha green mass or 20.3 t/ha dry matter.

### Table 1

<table>
<thead>
<tr>
<th>Harvesting period</th>
<th>Plant height cm</th>
<th>Stem</th>
<th>Leaf</th>
<th>Dry matter productivity, kg/m², green mass, g</th>
<th>Dry matter productivity, kg/m², dry matter, g</th>
</tr>
</thead>
<tbody>
<tr>
<td>First harvest</td>
<td>155</td>
<td>28.58</td>
<td>5.31</td>
<td>25.51</td>
<td>5.41</td>
</tr>
<tr>
<td>Second harvest</td>
<td>84</td>
<td>13.82</td>
<td>3.08</td>
<td>5.03</td>
<td>1.24</td>
</tr>
<tr>
<td>Third harvest</td>
<td>52</td>
<td>12.32</td>
<td>2.71</td>
<td>4.03</td>
<td>1.01</td>
</tr>
</tbody>
</table>

In some papers, results of the research on the productivity of *Galega orientalis* are given. In Russia forage mass productivity ranged from 18 to 70 t/ha, hay productivity ranged between 4.5 and 17.5 t/ha and the seed productivity was 200-300 kg/ha (Dzyubenko and Dzyubenko, 2008); in the second growing season, under the climatic conditions of Huhhot, China, the yield reached 14.5 t/ha hay (ZHI et al., 2009); in Yougoslavia the yield of hay ranged between 26.7 t/ha (I+II+III cutting), on the chernozem soils of neutral reaction, and 9.3 t/ha on weakly acid and acid soils – eutric cambisol ilimerized (Radenovic, 1996).

The productivity, the quality and the seasonal distribution of forage may be of great importance to the livestock producer. The quality of the hay made from fodder galega *Galega orientalis* are presented in Table 2. The hay prepared from the plants mowed for the first time, in full flowering period, contained 153 g/kg raw protein, 13 g/kg raw fats, 103 g/kg ash, 584 g/kg NDF, 386 g/kg ADF, 59 g/kg ADL, 322 g/kg CEL and 198 g/kg HC, dry matter digestibility was 62.7 % and organic matter digestibility 57.4%.

The hay prepared after the second harvest, in early flowering stage, contained 166 g/kg raw protein, 17 g/kg raw fats, 103 g/kg ash, 561 g/kg NDF, 368 g/kg ADF, 60 g/kg ADL, 308 g/kg CEL and 193 g/kg HC, dry matter digestibility was 63.8 % and organic matter digestibility 57.8 %. Finally, the hay prepared after the third harvest, in the budding period, contained 212 g/kg raw protein, 24 g/kg raw fats, 128 g/kg ash, 458 g/kg NDF, 315 g/kg ADF, 48 g/kg ADL, 267 g/kg CEL and 143 g/kg HC, dry matter digestibility was 72.9 % and organic matter digestibility 66.7 %.

The metabolizable energy value in prepared hay varied from 8.81 to 9.66 MJ/kg. We can mention that the hay obtained from the first and second
harvests, with calculated Relative Feed Value (RFV) 95-101, can be classified as fair to good quality, but from the third harvest RFV 131 – good quality.

The yield of digestible protein in the 7th growing season of Galega orientalis reached 2700 kg/ha protein.

Carotenes are precursors of Vitamin A – retinol, play a role in cell communication and immune function by protecting cells against free radicals, a deficiency in this vitamin may reduce reproductive efficiency in dairy cows, especially through impaired ovarian function and increased incidence of abortion. It was determined that the carotene content in Galega orientalis hay varied significantly in dependence of the harvest time: 30.1 mg/kg in hay from the first harvest, 52.5 mg/kg in the hay from the second harvest and 74 mg/kg – from the third harvest, correlating positively with leaves/stems ratios.

Some authors mentioned various findings about the quality of Galega orientalis hay. In conditions of semiarid continental east Croatia, fodder galega hay had higher proportion of leaves (44.90 % against 33.05 % in lucerne), protein concentration (20.85 % against 17.61 % in lucerne hay) and concentration of Mg, K and P, whereas lucerne hay had higher fibre content (39.67 % ADF and 45.21 % NDF against 39.09 % ADF and 43.98 % NDF in fodder galega hay) and Ca concentration than fodder galega hay.

Relative Feed Value of fodder galega hay was a little higher than that of lucerne hay (124 against 119), and calcium/phosphorus ratio in fodder galega hay was more favourable than in lucerne hay (Stjepanović et al., 2019).

### Table 2

<table>
<thead>
<tr>
<th>Indices</th>
<th>First harvest</th>
<th>Second harvest</th>
<th>Third harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw protein, %</td>
<td>15.3</td>
<td>16.6</td>
<td>21.2</td>
</tr>
<tr>
<td>Raw cellulose, %</td>
<td>37.3</td>
<td>33.7</td>
<td>29.0</td>
</tr>
<tr>
<td>Raw fats, %</td>
<td>1.3</td>
<td>1.7</td>
<td>2.4</td>
</tr>
<tr>
<td>Ash, %</td>
<td>10.3</td>
<td>11.6</td>
<td>12.8</td>
</tr>
<tr>
<td>Acid Detergent Fibre, %</td>
<td>38.6</td>
<td>36.8</td>
<td>31.5</td>
</tr>
<tr>
<td>Acid Detergent Lignin, %</td>
<td>5.9</td>
<td>6.0</td>
<td>4.8</td>
</tr>
<tr>
<td>Neutral Detergent Fibre, %</td>
<td>58.4</td>
<td>56.1</td>
<td>45.8</td>
</tr>
<tr>
<td>Cellulose, %</td>
<td>32.2</td>
<td>30.8</td>
<td>26.7</td>
</tr>
<tr>
<td>Hemicellulose, %</td>
<td>19.8</td>
<td>19.3</td>
<td>14.3</td>
</tr>
<tr>
<td>Lignin, %</td>
<td>5.9</td>
<td>6.0</td>
<td>4.8</td>
</tr>
<tr>
<td>Dry matter digestibility, %</td>
<td>62.7</td>
<td>63.8</td>
<td>72.9</td>
</tr>
<tr>
<td>Organic matter digestibility, %</td>
<td>57.4</td>
<td>57.8</td>
<td>66.7</td>
</tr>
<tr>
<td>Relative Feed Value</td>
<td>95</td>
<td>101</td>
<td>131</td>
</tr>
<tr>
<td>Metabolizable energy MJ/ kg</td>
<td>8.81</td>
<td>9.02</td>
<td>9.66</td>
</tr>
<tr>
<td>Carotene, mg/kg</td>
<td>30.1</td>
<td>52.5</td>
<td>74.0</td>
</tr>
</tbody>
</table>
2007). *Galega orientalis* hay prepared in West Ukraina contained 13.65 % crude protein, 1.66 % crude fats. 57.70 % NDF, 41.4 % ADF, 9.4% ADL (Darmohray, 2011).

**CONCLUSIONS**

1. In the 7th growing season fodder galega, *Galega orientalis* were characterised by faster grow and development rates, regenerative capacity after being cut.

2. The productivity of cv. *Speranţa* reached 101.5 t/ha green mass or 20.3 t/ha dry matter, 2700 kg/ha protein.

3. The hay prepared from *Galega orientalis* contained 153-212 g/kg raw protein, 13-24 g/kg raw fats, 103-128 g/kg ash, 458-584g/kg NDF, 315-386 g/kg ADF, 48-60 g/kg ADL, 62.7-72.9 % DMD, 57.4-67.7% OMD, with 8.81-9.66 MJ/kg ME and RFV 95-131.

   The cultivation of the cv. *Speranţa* of *Galega orientalis* would help solving acute problems related to the supply of qualitative hay to feed domestic animals, increasing the amount of nitrogen and humus in soil.

**REFERENCES**


