

*Contribuții Botanice* – 2014, XLIX: 67-73  
Grădina Botanică “Alexandru Borza”  
Cluj-Napoca

## SOME BIOLOGICAL PECULIARITIES AND VALUE OF THE FORAGE OF *ASTRAGALUS PONTICUS* PALL.

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**Abstract:** In order to alleviate the acute shortage of protein, it is necessary to extend the areas of crops rich in protein, such as those of the family *Fabaceae*. *Astragalus ponticus* Pall. plants, from the collection of non-traditional fodder plants of the Botanical Garden (Institute) of ASM, maintained in pure culture, served as the object of study. As a result of the research conducted, it was established that in order to germinate abundantly, seeds of *Astragalus ponticus* needed to be scarified and that in the first year of vegetation they had a slow growth and development. In the following years, *Astragalus ponticus* plants started to grow 5 days later than the traditional fodder crop *Medicago sativa* L. (lucerne or alfalfa), their flowering period started simultaneously, and the seeds ripened 26 days earlier. The seed production of *Astragalus ponticus* under the conditions in Moldova constituted 40.90g/m<sup>2</sup> (27.14 g/m<sup>2</sup> of the *Medicago sativa*). The maximum accumulation of green mass in *Astragalus ponticus* occurred during the budding stage and the harvest constituted 1.48 kg/m<sup>2</sup>, with a high content of dry matter. 1 kg of natural fodder contained 63.84 g raw protein, 47.27 g digestible protein and 7.90 g fats, compared with 46.10 g, 34.50 g and 20.0 g of *Medicago sativa*. The natural fodder of *Astragalus ponticus* had a high content of essential amino acids such as threonine, valine, isoleucine, lysine and a low content of methionine, phenylalanine and arginine. It was also rich in carotene and vitamin C, in minerals, especially phosphorus 1.23 g/kg, and had a high content of digestible protein, 225.09 g/nutritive unit (0.54 g/kg and 164.29 g respectively in *Medicago sativa*).

**Keywords:** *Astragalus ponticus*, amino acids, biochemical composition, biological peculiarities, nutritional value, yield.

### Introduction

In order to alleviate the acute shortage of protein in the food of humans and animals [14], requires the expansion of areas where protein crops are cultivated by mobilizing new species that would extend the assortment of both: cultures for the production of food for humans and the fodder necessary for the development of the animal husbandry sector, poultry farming and pisciculture. For the exploitation of eroded landscape, which have extended in recent years, the species of the family *Fabaceae* are of particular interest. Because of their assimilation and storage of nitrogen in soil (up to 100 kg N/ha. per year), these species can contribute to reducing emissions of greenhouse gases, and leguminous perennial fodder plants contribute to halting erosion, improving soil structure and reducing its acidification, increasing the favourable biodiversity for pollination, having an important role in enhancing the productivity and the quality of fodder, both when collected from pastures and meadows and in pure culture, heightening the nutritional value of the production obtained.

It is well known that the productivity of the grasslands from the Republic of Moldova is very low, constituting 300–500 kg/ha. of hay, and the share of leguminous fodder plants is decreasing [16]. Fodder legumes play an important role in increasing the quality of feed, due to a

significant contribution in protein, vitamins and minerals, which raise the nutritional value of feed and livestock production [1, 6]. The genus *Astragalus* L. comprises some 2,500 species and is the largest genus of Angiosperms [5]. In the spontaneous flora of the Republic of Moldova, 16 species occur [7], of which *Astragalus cicer* L. and *Astragalus ponticus* Pall. possess a certain forage value. The green mass of these species, used fresh, does not cause bloat in ruminant animals. One of them, *A. ponticus* Pall., is a rare species in Moldova, Ukraine and Russia [4,13]. In order to redress the situation regarding the increase of the productivity and the quality of fodder, it is necessary to extend the range of fodder leguminous species and to carry out reseeded works. One of the causes of the reduced use of the representatives of the genus *Astragalus* L. as feed for animals is the insufficient knowledge of the biological characteristics of these species, the biochemical composition of these plants and their fodder value [1,2]. These aspects have determined the choice of the object of this study.

The Botanic Garden (Institute) of A.S.M.'s collection of non-traditional fodder plants totals nearly 280 species and varieties, inclusive 68 leguminous plants. Scientific investigations performed in the last 60 years have focused on improving and implementing new species, and new forms and varieties, and cultivation technologies have been developed [11,12].

### Materials and Methods

*Astragalus ponticus* Pall. plants, from the collection of non-traditional fodder plants of the Botanic Garden (Institute) of A.S.M, maintained in pure culture, served as object of study. *Medicago sativa* L. (lucerne or alfalfa), *Trifolium repens* L. (white or Dutch clover) and *Lotus corniculatus* L. (bird's-foot trefoil) served as control legumes. These species are widespread in the wild flora of Romania and Republic of Moldova. Setting up of experiments was performed with previously scarified seeds of *Astragalus ponticus* on chernozem as usual in spring when the soil had reached physical readiness. The seeds were planted at a depth of 1.5–2.0 cm, with soil compaction before and after sowing. The test area of the plot constituted 10 m<sup>2</sup>; the number of replicates – 4. The scientific researches on growth and development, yield and nutritional value of the plants were carried out according to established methods [3,8,9].

### Results and Discussions

As a result of the research carried out, it has been established that, in order to germinate abundantly, the seeds of *Astragalus ponticus* need to be scarified [15]. In the first year of growth, these species, by comparison with *Medicago sativa*, *Trifolium repens* and *Lotus corniculatus*, exhibit slow growth and development, reaching only the stage of forming the stem with leaves. At the end of the first year of vegetation the plants reach 12–16 cm tall.

In the following years, the growth and development of plants of *Astragalus ponticus* (Table 1) begins when positive temperatures are established, in the second half of March, 4–7 days later compared to the other species. The growth rate of this species, in the first 20 days of vegetation, is faster by comparison with *Trifolium repens* and *Lotus corniculatus*, reaching 27.2 cm, but is slower by comparison with *Medicago sativa*. This tendency is maintained during growth, so that, in the flowering period, the plants of *Astragalus ponticus* reach 76 cm in height (Photo 1). It can be mentioned that flower bud formation and flowering of the species studied starts around the same time, also, from the restart of vegetation this period comprises in *Astragalus ponticus* 66–77 days and 75–82 days in *Medicago sativa*.



Photo 1: *Astragalus ponticus* Pall.

*Astragalus ponticus* plants are characterized by a shorter period of seed formation and ripening. So, the period ‘beginning of growth–seed ripening’ constitutes 117 days compared with 143 days in *Medicago sativa*.

Seed production is a key pillar in the capacity of maintenance and expansion of the species. Analyzing the data presented in the Table 2, we should mention that a high production of seeds has been found in *Astragalus ponticus* (c. 40.9 g/m<sup>2</sup>), but because the seeds are large, this species produces the lowest number of seeds per unit area. A larger quantity of seeds is formed in the two species *Trifolium repens* (27 thousand/m<sup>2</sup>), and *Lotus corniculatus* (21 thousand/m<sup>2</sup>).

Table 1: Biological peculiarities of the species of *Fabaceae* studied

Indicators	<i>Astragalus ponticus</i> Pall.	<i>Medicago sativa</i> L.	<i>Trifolium repens</i> L.	<i>Lotus corniculatus</i> L.
Beginning of growth	17.03	12.03	10.03	13.03
Days from the beginning of growth up to:				
budding	66	75	71	63
flowering	77	82	82	77
seed ripening	117	143	119	121
Plant height, cm				
- at 20 days of growth	27.2	38.1	22.0	26.7
- at flowering	76.0	83.2	31.3	42.3

The yield of green mass is an overall indicator of the value of fodder species [1]. At the first mowing, in the period of flower bud formation–flowering, the fresh mass yield of *Astragalus ponticus* constitutes 1.48 kg/m<sup>2</sup>, exceeding by far that of the *Trifolium repens* plants.

By a higher yield of fodder, the species *Medicago sativa* and *Lotus corniculatus* stand out. It is known that the correlation “leaves–stem” influences the nutritional value of the fodder. The natural fodder of *Astragalus ponticus* is characterized by the highest content of leaves (56%) and the lowest (41–42 %) – *Trifolium repens* and *Medicago sativa*.

**Table 2: The yield of the studied species of Fabaceae studied**

Indicators	<i>Astragalus ponticus</i> Pall.	<i>Medicago sativa</i> L.	<i>Trifolium repens</i> L.	<i>Lotus corniculatus</i> L.
The yield:				
- fresh mass 1-st cut , kg/m <sup>2</sup>	1.48	1.67	0.83	1.58
- dry matter, kg/m <sup>2</sup>	0.40	0.44	0.28	0.55
The leaf share of the fodder, %	56	42	41	49
Seed production, g/m <sup>2</sup>	40.90	27.14	19.12	22.30
The weight of 1000 seeds, g	8.44	2.67	0.71	1.05

Animals, in order to maintain their vital functions and to give different productivity, need a permanent exogenous source of nutrients which they receive from their feed and, after the process of digestion and assimilation, are used by their body to provide the following functions: plastic, energetic and biocatalytic. Proteins are very important nutritive substances that provide a source of assimilable nitrogen for the body [1, 6]. Analyzing the biochemical composition of the natural fodder of the species studied (Table 3), we find that *Astragalus ponticus* is distinguished by a very high content of raw protein (63.84 g/kg), which is 67–75% higher compared to the species *Trifolium repens* and *Lotus corniculatus*. A high capacity of nitrogen accumulation by *Astragalus ponticus* is also recorded in other papers [2].

It should be mentioned that the natural fodder value of *Astragalus ponticus* includes a higher content of dry matter – protein, fat and cellulose – compared with *Medicago sativa*. The species *Trifolium repens* and *Lotus corniculatus* are characterized by the highest level of accumulation of dry matter, especially of cellulose and nitrogen-free extractable substances, in the natural fodder that has contributed to the growth of the level of accumulation of metabolisable energy for cattle ( 3.033.07 MJ/kg ).

The mineral substances in the animal feed contribute to the growth and health of animals, because they are essential components of all the tissues and organs that maintain at a constant level the osmotic pressure, participate in the regulation of acid-base balance, activate a number of enzymes, moderate neuromuscular activities, and prevent the occurrence and development of some diseases of animals [10]. *Lotus corniculatus* and *Astragalus ponticus* have a high content of minerals in their natural fodder. It can be mentioned that *Astragalus ponticus* has a lower calcium content in the fodder, but has the highest level of phosphorus – 1.23 g/kg.

The natural fodder value of the species studied differs in the content of some vitamins (carotene, vitamin C). As regards the carotene content in the natural fodder, *Astragalus ponticus* exceeds by 1.9 to 2.8 times the species *Lotus corniculatus* and *Trifolium repens*, but the content of vitamin C exceeds all the investigated species.

**Table 3: Biochemical composition and nutritional value of natural fodder**

Indicators	<i>Astragalus ponticus</i> Pall.	<i>Medicago sativa</i> L.	<i>Trifolium repens</i> L.	<i>Lotus corniculatus</i> L.
<b>1 kg of natural fodder contains:</b>				
nutritive units	0.21	0.21	0.20	0.25
metabolizable energy for cattle, MJ/kg	2.43	2.28	3.03	3.07
dry matter, g	272.40	263.70	335.00	346.70
raw protein, g	63.84	46.10	38.11	36.40
digestible protein, g	47.27	34.50	28.96	26.57
raw fats, g	7.90	6.20	7.04	11.09
raw cellulose, g	86.90	80.30	140.70	99.16
nitrogen-free extractable substances, g	87.61	99.30	128.38	168.50
mineral substances, g	26.15	21.70	20.77	31.55
calcium, g	2.34	4.61	4.56	4.85
phosphorus, g	1.23	0.54	0.84	0.76
carotene, g	17,0	14,0	6,0	10,0
vitamina C, mg/%	310,0	172,0	149,6	122,4
digestible protein, g/ nutritive unit	225.09	164.29	144.80	106.28

**Table 4: The content of amino acids in the fodder (mg/100mg dry matter)**

Amino acids	<i>Astragalus ponticus</i> Pall.	<i>Medicago sativa</i> L.	<i>Trifolium repens</i> L.	<i>Lotus corniculatus</i> L.
asparagine	3,110	1.711	1.593	1.129
threonine	0,678	0,564	0.559	0.633
serine	0,767	0,687	0.663	0,767
glutamine	1,953	1,360	1.381	0.941
proline	0,765	0,922	1.062	0.355
glycine	0,676	0,550	0.613	0.477
alanine	0,570	0,674	0.665	0.607
valine	0,649	0,559	0.621	0.369
methionine	0,058	0,139	0.052	0,117
isoleucine	0,510	0,459	0.453	0.315
leucine	0,914	0,913	0.929	0.816
tyrosine	0,458	0,458	0.517	0.319
phenylalanine	0,794	0,850	0.806	0.416
histidine	0,411	0,326	0.364	0.136
lysine	0,760	0,619	0.658	0,517
arginine	0,306	0,655	0.584	0.402

The natural fodder value of the species studied is assured, according to zootechnical standards, with digestible protein, the highest content being in the fodder of *Astragalus ponticus* (225.09 g per nutritive unit) or 37% more than *Medicago sativa*, 56% than *Trifolium repens* and 118% than *Lotus corniculatus*.

The nutritional value of the fodder is determined by the content of certain amino acids that ensure the biological value of protein. It can be mentioned that, in comparison with the studied species (Table 4), the fodder of *Astragalus ponticus* is characterized by a higher content of amino acids. Analyzing the content of each essential amino acid, we have found that at *Astragalus ponticus* the content of threonine, valine, isoleucine, leucine, histidine and lysine is higher, but the content of methionine is lower (2.0-2.4 times) as compared with *Lotus corniculatus* and *Medicago sativa*.

### Conclusions

The fodder obtained from *Astragalus ponticus* Pall. is valuable: rich in protein, essential amino acids, fats and a high level of vitamins, mineral substances, and special phosphorus.

The results obtained are a positive reason for further research on the peculiarities of growth and development of *Astragalus ponticus* in different phytocoenoses.

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### UNELE PARTICULARITĂȚI BIOLOGICE ȘI VALOAREA FURAJERĂ A SPECIEI *ASTRAGALUS PONTICUS* PALL.

#### (Rezumat)

În contextul deficitului acut de substanțe proteice e necesar extinderea suprafețelor de culturi proteingenoase, un interes deosebit reprezentând plantele din familia *Fabaceae* Lindl. În calitate de obiect de studiu au servit plantele de *Astragalus ponticus* Pall. menținute în cultura pură din colecția de plante furajere netradiționale ale Grădinii Botanice (Institut) a AȘM. În rezultatul cercetărilor efectuate s-a stabilit că pentru o încolțire uniformă și omogenă, semințele de *Astragalus ponticus* necesită a fi scarificate, în primul an de vegetație plantele au o creștere și dezvoltare lentă. În următorii ani, plantele de *Astragalus ponticus* își reiau vegetația cu 5 zile mai târziu comparativ cu cultura furajeră tradițională de *Medicago sativa* L., însă perioada de înflorire fiind concomitentă, iar coacerea semințelor cu 26 zile mai devreme. Productivitatea semincieră la *Astragalus ponticus* în condițiile Republicii Moldova constituie 40.90 g/m<sup>2</sup> comparativ cu 27.14 g/m<sup>2</sup> la *Medicago sativa*. S-a stabilit că acumularea maximă de furaj natural la *Astragalus ponticus* este în faza de formare a butonilor florali și recolta constituie 1.48 kg/m<sup>2</sup> având un conținut ridicat de substanță uscată. La 1 kg de furaj natural revin 63.84g proteina brută, 47.27 g proteina digestibilă și 7.90 g grăsimi, la *Medicago sativa* respectiv 46.10 g, 34.50 g și 6,20 g. Furajul natural de *Astragalus ponticus* are un conținut ridicat de aminoacizi esențiali, cum ar fi treonină, valină, izoleucină, lizină și mai diminuat de metionină, fenilalanină și arginină. Este de asemenea, bogat în caroten, vitamina C, substanțe minerale, în special fosfor 1.23 g/kg, și are o bună asigurare cu proteină digestibilă 225,09 grame pe unitate nutritivă (la *Medicago sativa* respectiv 0.54 g / kg și 164.29 g).

Received: 1.07.2014; Accepted: 28.10.2014.