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## Biochemical Features of *Medicago varia* Mart. Growing in Flood-Plain Meadows and on the Chetace Slopes of the Belgorod Region

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**Abstract.** The article presents the results of studying the biochemical characteristics of alfalfa growing in floodplain meadows and on the chalk slopes of the Belgorod region. It has been established that when wild-growing forms of alfalfa are transplanted into culture, in terms of the content of alfalfa individuals grown in the meadow grown on chalk slopes, the differences in the content of crude protein were insignificant - 3.3%. According to the content of fat, soluble carbohydrates (nitrogen-free extractive substances) and ash, individuals grown on chalk slopes were inferior by 30.0%, 8.2% and 13.8%, respectively. Only in the content of fiber they surpassed the individuals grown in the meadow by 16.6%.

**Key words:** biochemical composition, fodder crop, cenopopulation, crude protein, fat, fiber.

### Introduction

The study of the impact of climate change on natural ecosystems is topical. At the same time, the study of ecological, morphological, physiological and biochemical characteristics of plants depending on habitats, ecotopes, and climatic conditions has become an urgent task. For this purpose, various plant objects are involved in the scope of research. And first of all, the most widely distributed throughout the world, including in temperate climates, alfalfa species, especially *Medicago varia* Mart. (alfalfa variable).

For the south of the Central Russian Upland, *M. varia* is one of the typical objects of study. Long-term studies have shown that the carbonate soils of the Central Russian Upland have a negative effect on the growth and development of alfalfa. Active research is underway on the specific impact of carbonate soil on the biological and ecological characteristics of alfalfa [Dumacheva, Chernyavskikh, 2014a; Dumachev and Chernyavskikh, 2014b].

Biochemical studies provide greater fundamentality in understanding the phenomenon of plant resistance to specific environmental factors [Konarev et al., 2000].

Researchers are studying the biochemical composition of alfalfa, but so far, work in this direction is not active enough. There are studies that, when studying the chemical composition of the aboveground organs of alfalfa, revealed, in addition to proteins, fats and carbohydrates and a high content of vitamins (which ensures the nutritional quality of alfalfa), a whole group of biologically active substances [Eremenko et al., 2014; Kovalov et al., 2008; Gatouillat, 2015; Ding, 2013]. V.E. Nikitin, referring to the works of A.I. Ivanova, I.P. Gavriluk, E.E. Aggie (1979), L.V. Polyakova and E.A. Ershova (2000) notes that perennial alfalfa is characterized by a certain level of intrapopulation variability in terms of biochemical characteristics (Nikitina, 2007). D.N. Doev notes, referring to numerous studies, that with a change in leafiness and the ratio of leaves and stems, the chemical composition of the aerial parts of alfalfa plants also changes. He also notes that a lack of nitrogen in the diet leads to an increase in more than two times the content of sparingly soluble proteins. And the lack of phosphorus and potassium in the composition of the soil changes the content of some protein fractions (Doev, 2017).

Indicators of the biochemical composition of the aboveground phytomass are important for individuals of

variable alfalfa, since this crop is considered, first of all, as a fodder crop [Chernyavskikh, 2009, 2016; Chernyavskikh et al., 2012]. And the assessment of the nutritional merits of the selected cenopopulations makes it possible to identify ecotypes that are promising for further breeding work. In this regard, we studied the biochemical characteristics of alfalfa growing in floodplain meadows and on the chalk slopes of the Belgorod region.

### Characteristics of the study area

The Belgorod region is located in the south of the central black earth zone and occupies the southern and southeastern slopes of the Central Russian Upland. The height above sea level rises to 100-200 meters. The climate of the region is characterized by continentality. Summers are hot and winters are comparatively cold. The average annual air temperature varies from +5.4 degrees in the north to +6.8 degrees in the southeast. The frost-free period is 155–160 days, the duration of solar time is 1800 hours. The average air temperature in July ranges from 18.3° to 21.2°C. The absolute maximum air temperature reaches 36°–41°C. The temperature of the warmest month - July is observed in the third decade and averages 20.7°. The absolute annual minimum is –36°–38°. The average air temperature in January is –7.8°, and the annual amplitude is 72–79°C.

The amount of precipitation per year ranges from 150 to 590 mm. Precipitation is unevenly distributed throughout the region. This is due to the diversity of the relief. The maximum amount of precipitation occurs in June–July, and the minimum in January–February (Lebedeva et al., 2015).

### Material and research methods

For research, model alfalfa cenopopulations (CPP) were selected and studied in various regions of the Belgorod region. Of the twelve populations that were studied, six were located in floodplain meadows, in the floodplains of small rivers of the Belgorod region (CPP-1 - CPP-6) and six were located on chalk slopes, areas of beams and tracts with writing chalk on the surface (CPP-7 - CPP-12).

In each of the studied cenopopulations in 2019, 10 alfalfa specimens were selected, which were vegetatively transplanted into the Botanical Garden of the Belgorod State National Research University for further study. This was done in order to level the growing conditions, soil and climatic differences and to accurately assess the performance of wild alfalfa plants without the influence of the habitat (observance of the single difference principle). Alfalfa specimens were planted on single-row plots. Planting distance - between individuals 0.5 m, distance between plots - 0.5 m. , nitrogen-free extractive substances (BES), ash (%)).

The following chemical indicators were studied: dry matter (content, %), protein (content, %), fat (content, %), fiber (%), soluble carbohydrates (content, %), ash substances (content, %).

Chemical analyzes were carried out in compliance with the requirements of GOSTs in the laboratory of Belgorod State Agrarian University named after V.Ya. Gorin. Sample preparation was carried out according to the method (Pshleshkov, 2013). A nursery for the study of alfalfa specimens was established in compliance with standard requirements. Each individual of alfalfa was considered as one biological replication. The results of experiments and studies were processed using the methods of mathematical statistics [Dospekhov, 2012].

### Results and its discussion

The results of biochemical analyzes showed that alfalfa individuals growing on floodplain meadows are characterized by higher values of dry matter, crude protein, fats, soluble carbohydrates (NES) and ash than individuals from cenopopulations growing on chalk slopes.

The study of the dry matter content of the green mass of alfalfa harvested in the phase of the beginning of flowering showed that when growing on floodplain meadows, the dry matter content is the highest (23.7%), compared with the green mass of alfalfa growing on chalk slopes (19.2%) . 1 kg of dry matter of alfalfa in CPP 1-6 contains 18.0% of crude protein, while in plants of CPP 7-12 this figure is 17.4%. At the same time, in plants on chalk slopes, the amount of crude fiber increases to 20.4%.

As can be seen from tables 1 and 2, the amount of fat, NES and ash in the composition of alfalfa growing in both cenopopulation groups did not change much. The plants of the chalk slopes contain 2.1% fatty acids, 23.5% NES and 6.9% ash, while in the plants of floodplain meadows these figures are 3.0, 25.6 and 8.0%, respectively.

Table 1

The content of individual chemicals in the aboveground mass of individuals of variable alfalfa, selected in floodplain meadows of the Belgorod region, when transplanted into culture

CPP	Dry matter, %	Crude protein, %	Cellulose, %	Fat, %	NES, %	Ash, %
CPP 1	24,1	18,5	16,22	3,02	26,97	7,32
CPP 2	22,3	17,4	17,66	3,33	24,09	7,89
CPP 3	24,15	17,8	19,83	2,89	25,11	8,72
CPP 4	24,6	19,7	15,33	2,34	27,51	7,48
CPP 5	23,15	16,8	17,83	2,77	24,11	8,64
CPP 6	23,65	17,5	17,96	3,77	26,1	7,89
M	23,7	18,0	17,5	3,0	25,6	8,0
m	0,6	0,8	1,1	0,4	1,2	0,5
Sx	0,8	1,0	1,6	0,5	1,4	0,6
Cv	3,5	5,7	8,9	16,2	5,7	7,3

M - arithmetic mean; m - error of the arithmetic mean; Sx - relative error of the sample mean; Cv - is the sum of the squares of the central deviations of the options

Table 2

The content of individual chemicals in the aboveground mass of individuals of variable alfalfa, selected on the Cretaceous outcrops of the Belgorod region, when transplanted into culture

CPP	Dry matter, %	Crude protein, %	Cellulose, %	Fat, %	NES, %	Ash, %
CPP 7	18,7	16,8	19,6	2,3	25,8	6,6
CPP 8	18,9	16,7	21,4	1,9	24,9	7,3
CPP 9	19,6	18,3	18,1	2,6	22,3	7,5
CPP 10	20,5	17,8	22,6	1,6	21,5	6,4
CPP 11	21,6	17,6	21,3	2,0	25,2	6,8
CPP 12	18,6	17,3	19,1	2,1	21,3	6,5
M	19,7	17,4	20,4	2,1	23,5	6,9
m	0,9	0,5	1,4	0,2	1,8	0,4
Sx	1,2	0,6	1,7	0,3	2,0	0,4
Cv	6,0	3,5	8,3	15,3	8,6	6,5

M - arithmetic mean; m - error of the arithmetic mean; Sx - relative error of the sample mean; Cv - is the sum of the squares of the central deviations of the options

Comparative characteristics of the average values of biochemical parameters in the above-ground mass of alfalfa specimens selected in floodplain meadows and on chalk outcrops of the Belgorod region, when transplanted into cultivation, is shown in the figure.

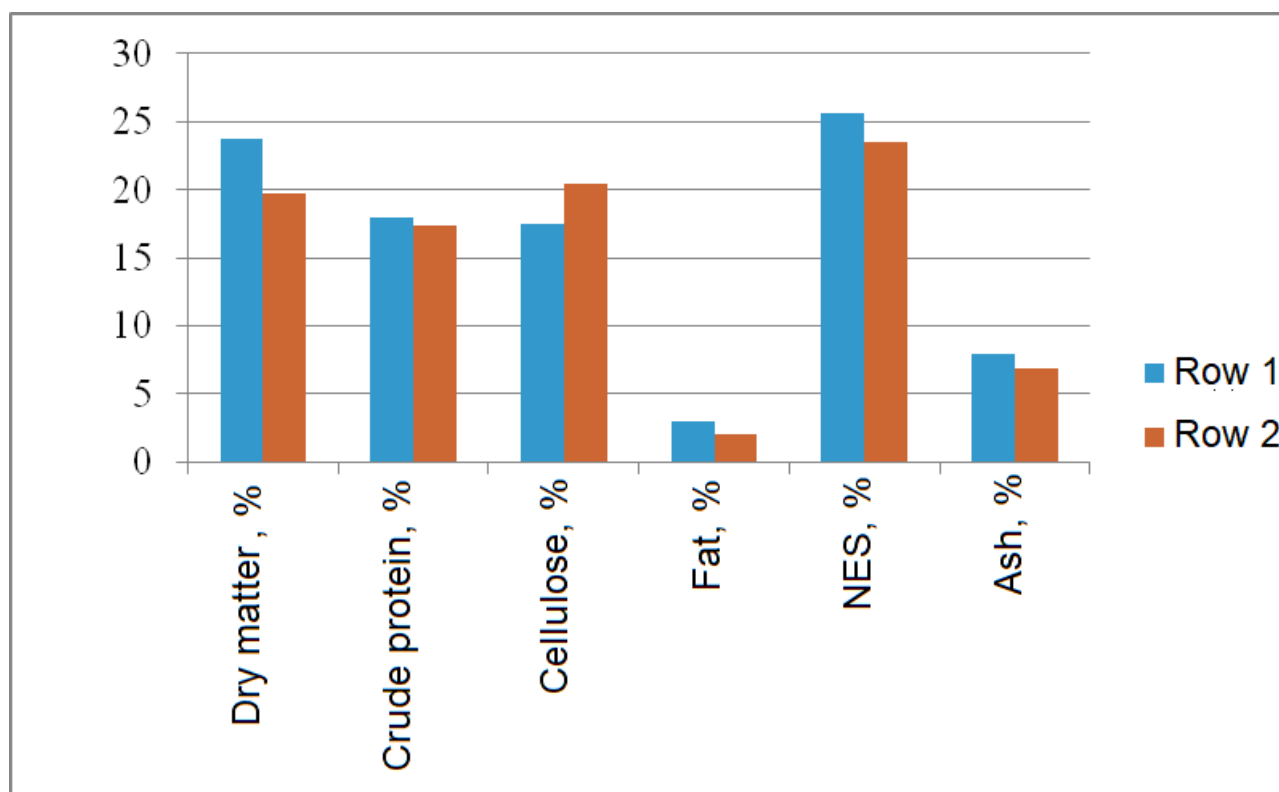


Figure – Comparative characteristics of the average biochemical parameters of the studied alfalfa individuals:

Row 1 – samples of alfalfa transplanted from floodplain meadows into culture;

Row 2 - samples of alfalfa transplanted from the chalk slopes into the culture

**Conclusion**

When transplanting wild-growing forms of alfalfa into cultivation, the differences in the content of crude protein from alfalfa specimens obtained in the meadow grown on chalk slopes were insignificant (3.3%). According to the content of fat, soluble carbohydrates (nitrogen-free extractive substances) and ash, individuals grown on chalk slopes were inferior by 30.0%, 8.2% and 13.8%, respectively. Only in the content of fiber they surpassed the individuals grown in the meadow by 16.6%. Thus, significant differences in biochemical parameters have been established in alfalfa individuals transplanted from different habitats into culture. Further studies are needed to determine the extent to which these differences are genetically determined and fixed in the offspring.

**References**

- Nikitina Ye.V. 2007. Vnutripopulyatsionnaya izmenchivost lyutserni posevnoy (*Medicago sativa* L.) po sodержaniyu antipitatelnix soyedineniy. Avtoref. diss. .... kand. biol. nauk. SPb. 20 p.
- Doyev D.N. 2017. Otsenka bioresursnogo potentsiala lyutserni (*Medicago varia* Mart.) pri ispolzovanii mestnix shtammov klubnikovix bakteriy roda Sinorhizobium v usloviyax vertikalnoy zonalnosti RSO-Alaniya: diss. .... kand. biol. nauk: 03.02.14. Vladikavkaz, 212 p.
- Dospheov B.A. 2012. Metodika polevogo opita: (S osnovami statisticheskoy obrabotki rezultatov issledovaniy) [Methodology of field experience: (With the basics of statistical processing of research results)]. M.: Kniga po Trebovaniyu, 352 p.
- Dumacheva E.V., Chernyavskikh V.I. Bioresource potential of leguminous grasses on chalk outcrops and carbonate soils of European Russia: [monograph] - Belgorod: Publishing House "Belgorod", 2014a. –144 s.
- Dumacheva E.V., Chernyavskikh V.I. Spatial structure and age spectrum of *Medicago* L. cenopopulations in ravine-gully complexes in the south of the Central Russian Upland // Modern Problems of Science and Education. – 2014b. – No. 4. URL: <https://science-education.ru/ru/article/view?id=13868> (date of access: 03/31/2023).
- Yeremenko R.F., Maloshtan L.N., Sherbak A.A. 2013. Izucheniye vliyaniya korrektera belkovogo obmena ekstrakta iz travi lyutserni posevnoy na uroven tireoidnix gormonov - Problemi Yekologichnoï Ta Medichnoï Genetiki I Klinichnoï Imunologii, 1 (115): 105-111.
- Kovalyov S.V., Kovalyova A.M., Cremenko R.F. 2008. Doslidjennya fenolnogo kompleksu iz travi lyutserni posivnoï - Farmatsevtichniy chasopis. №2 (6): 27–30.
- Konarev A.B., Konarev V.G., Gubareva N.K. 2000. Peneva T.I. Belki semyan kak markeri v reshenii problem geneticheskix resursov rasteniy, seleksii semenovodstva. Sitologiya i genetika, 34 (2): 91–104.
- Lebedeva M.G., Soloviev A.B., Tolstopyatova O.S. Agro-climatic zoning of the Belgorod region in a changing climate // Scientific Bulletin of the BelSU. –2015. N 9 (206), issue 31. -WITH. 160-167.
- Pleshkov B.P. Biohimiya sel'skohozyajstvennyh rastenij [Biochemistry of agricultural plants]. 2013. M.: Kniga. po Trebovaniyu. 496 p.
- Chernyavskikh V.I. 2009. Productivity of legumes-grass mixture and effectiveness of their cultivation on the slope lands of the southwest Of CCZ. Achievements Of Science And Technology In Agro-Industrial Complex, 7: 42–45.
- Chernyavskikh V.I. 2016. Rekurrentnaya selektsiya kak osnova povysheniya produktivnosti lyutserny v Tsentral'no-Chernozomnom regione [Recurrent selection as the basis for increasing the productivity of alfalfa if the Central Chernozem Region]. Kormoproizvodstvo, 12: 40–44.
- Chernyavskikh V.I., Titovsky A.G., Sharko R.A., Shinkarenko O.V., Dumacheva E.V. 2012. Experience of breeding and seed production of alfalfa and other grasses in CJSC «Krasnaya Yaruga Grain Company». Achievements Of Science And Technology In Agro-Industrial Complex, 12: 14–17.
- Ding W.H., Xu H.Y., Wang D.D., Li J., Tian S.G. 2013. Quality standard of uygur medicine *Medicago sativa* seeds. Zhongguo Zhong Yao Za Zhi. Nov., 38 (21): 3782–3785.
- Gatouillat G., Magid A.A., Bertin E., Okiemy-Akeli M.G., Morjani H., Lavaud C., Madoulet C. 2014. Cytotoxicity and apoptosis induced by alfalfa (*Medicago sativa*) leaf extracts in sensitive and multidrug-resistant tumor cells. Nutr. Cancer., 66 (3): 483–491.