Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Agriculture
Open Access

Ecological, Agronomic and Anthropogenic Characterization of the Habitat *62C0* Ponto-Sarmatian Steppes* in the North of Dobrogea (Romania)

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RESEARCH ARTICLE

Abstract

Natural habitat of Community interest 62C0* Ponto-Sarmatian steppes is very important at European level due to its high biodiversity. The aim of the paper is to study the grassland systems within the habitat 62C0* Sarmatic pontoon steps and to characterize them from an ecological and agronomic point of view. The floristic studies were carried out on the permanent grasslands of the biogeographical region ROSCI 0201 North Dobrogean Plateau, which for the most part belong to the Natural Habitat of Community Interest 62C0 * Sarmatian pontoon steps. Following the classifications (cluster) resulted 4 groups such as: type *Cynodon dactylon*, type *Bothriochloa ischaemum - Festuca valesiaca*, type *Festuca valesiaca* and type *Festuca valesiaca - Stipa capillata*.

Keywords: HNV grasslands, habitat 62C0*, Stepe ponto sarmatice, ecological and agronomic value.

Received: 27 October 2022
Accepted: 09 November 2022
Published: 15 November 2022

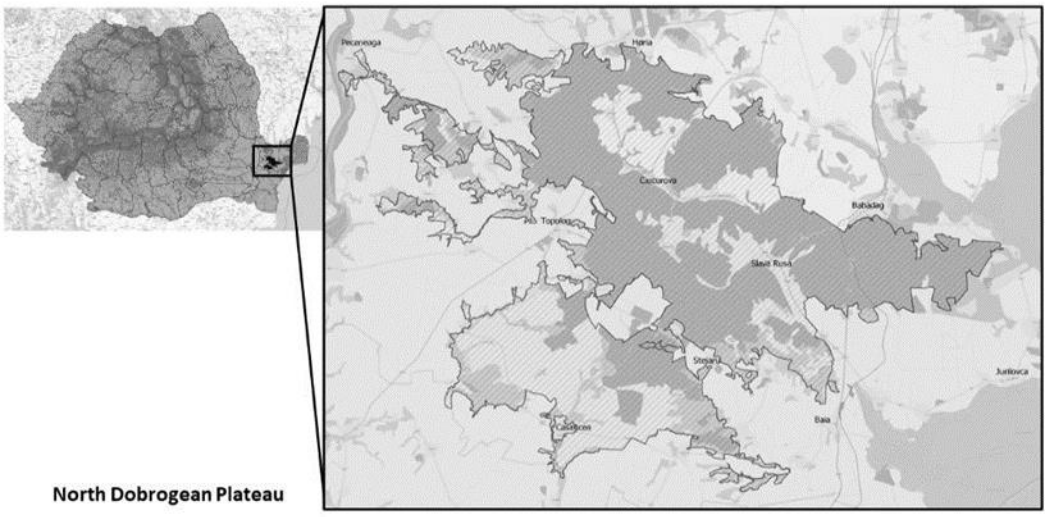
DOI:
10.15835/buasvmcn-agr:2022.0027

INTRODUCTION

Natural habitat of Community interest 62C0* *Ponto-Sarmatian* steppes is very important at European level due to its high biodiversity (Anastasiu et al., 2008; 2021; Ghendov et al., 2020; Polchaninova et al., 2021). The priority habitat type 62C0* *Ponto-Sarmatic steppes* is present in the South-Eastern part of Romania in the Steppic Region, but it is also present on the steep Southern exposed hill slopes of the Transylvanian Tableland (Oprea and Sârbu, 2009; Schneider-Binder, 2015). In ROSCI0201 Podişul Nord Dobrogean, protected area of community importance, is to preserve several rare plant species identified in 62C0 * *Ponto-Sarmatic steppe* habitat (Marusca et al., 2020). The most serious threat for these grasslands is vegetation succession, while grazing seems to be the most important factor for their conservation (Fotiadis and Papanastasis, 2013). The habitat 62C0* *Stepe ponto sarmatice* is partly depending on the continuation of agricultural management (Halada et al., 2011; Luick, 2014). Phytosociological, ecological and economic aspect regarding these habitats still needs to be debatede (Fotiadis and Papanastasis, 2013). Grassland ecosystems (especially HNVs) need a clearer picture, which can be obtained by analyzing agricultural management indicators combined with those of biodiversity assessment (Vaida et al., 2021). The aim of the paper is to study the grassland systems within the habitat 62C0* Sarmatic pontoon steps and to characterize them from an ecological and agronomic point of view.

MATERIALS AND METHODS

The floristic studies were carried out on the permanent grasslands of the biogeographical region ROSCI 0201 North Dobrogean Plateau, which for the most part belong to the Natural Habitat of Community Interest 62C0 * Sarmatian pontoon steps (Figure 1).



Source: Maruşca T. et al

Figure. 1 Location of the research area.

The floristic composition was interpreted using an improved Braun-Blanquet scale with subdivisions (Păcurar and Rotar, 2014). Sward fodder value was calculated based on species quality score on a scale from 1 (poor) to 9 (excellent), after Dierschke and Briemle (2002), as modified by Păcurar and Rotar (2014). Sward fodder value was performed on a scale from 1 (poor sward, quality dominated by toxic species) to 9 (excellent) after Păcurar and Rotar (2014). Data regarding the share of economic groups (*Poaceae, Cyperaceae - Juncaceae, Fabaceae* and other botanical families- OFB), species number were processed by analysis of variance. Plant resistance against interference mechanical, such as mowing, grazing and crushed materialized by value indicator (from 1-9) after Dierschke and Briemle (2002), and the names of appropriate species depending on the category disturbance were taken after Păcurar and Rotar (2014). Based on data from spectrum it can be calculate the average indicator of a phytocenosis. This may be unweighted or weighted. Assigning a phytocenosis feed is achieved at the expense calculated weighted average indicator value. Using descriptive statistics (Cristea et al*.,* 2004) analyzes were performed which are divided into two categories: central tendency parameters and indicators of scattering data. In the central tendency parameters included those processes provide a representative value (central) measured for the data stream. Currently, in Romania, specialists are trying to assess the management of high-biodiversity (HNV) grasslands with the help of species with indicator value and to draw up a list of species taking into account the stationary conditions and the intensity of the management used (Vaida et al., 2021; Gaga et al., 2022). There are three estimators that can be used for this purpose: the mean, median and module. Species with indicator value for HNV systems were taken after Indicator species for grasslands with High Natural Value from the site Ministry of Agriculture and Rural Development.

RESULTS AND DISCUSSIONS

Following the classification with the program PC - ORD (version 7) resulted a graphical representation (dendogram; Figure 2) which records the evolution in which the floristic reliefs are classified, but also shows us the distance between them. According to the literature, the level at which the dendogram will be cut is where the resulting groups have a justified phytosociological and ecological meaning, but also at a level whereas much information as possible remains (Peck, 2010). The data of the floristic surveys were classified according to the distance index, Euclidean. Following the analysis of the floristic composition, we considered that cutting the value of 30 is the best solution in our case, as it has a phytosociological, ecological and agronomic meaning. Thus, 4 distinct groups were identified (cluster; Figure 2) built by the following types of meadows: type *Cynodon dactylon* (cluster 1), type *Bothriochloa ischaemum – Festuca valesiaca* (cluster 2), type *Festuca valesiaca* (cluster 3) şi type *Festuca valesiaca – Stipa capillata* (cluster 4).

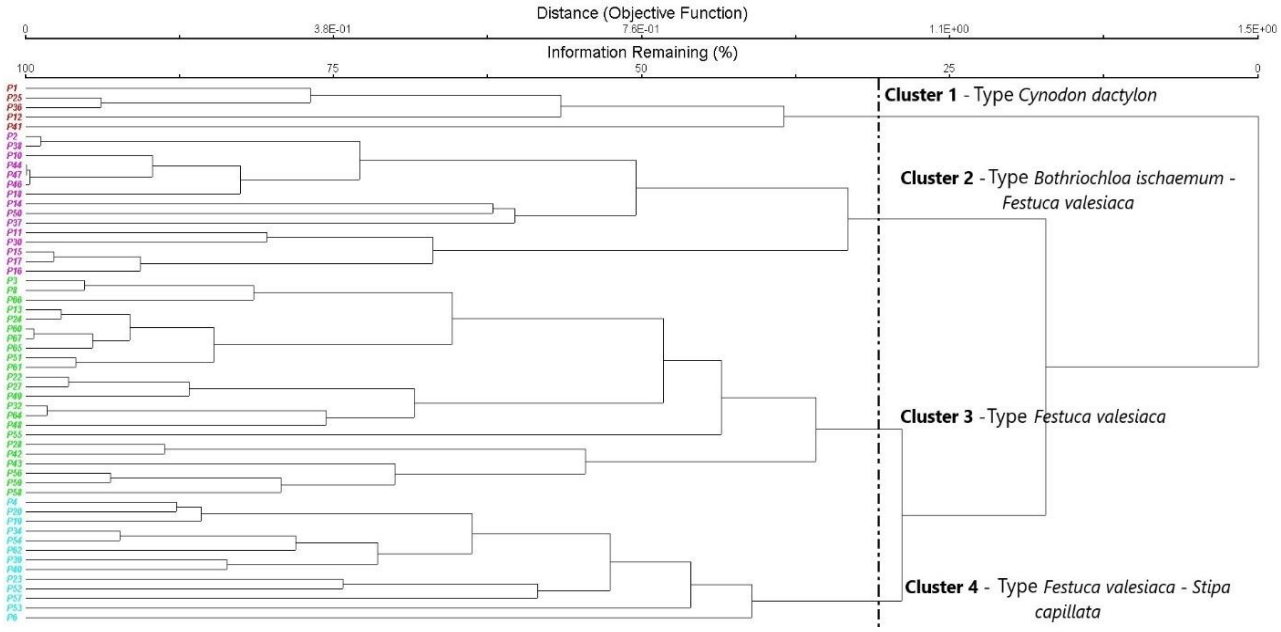


Figure 2. Dendrogram of floristic plots classification

Species with indicative value are those that bring valuable information to the researcher regarding the environmental conditions, the application of maintenance works and the way of use, the level of anthropogenic influence, etc. The information provided by indicator species can overlap and, in this way, valuable information can be obtained on the seasonal conditions of a certain phytocenosis and the intensity of management. Once the phytocenosis situation has been established, practical management strategies can be developed, which include maintenance and use work corresponding to the purpose. For example, indicator species may be particularly useful for high value natural pastures (HNV), for which a clear picture (phytodiversity assessment) and appropriate practical management must be established (Krautzer and Pötsch, 2009, Rotar et al., 2020, Vaida and et al., 2021). The indicator species for soil conditions are useful tools to correct some limiting properties for the productivity and biodiversity of steppe grasslands and to establish their integrated management measures (Marusca et al., 2020).
In our paper, based on the analysis of indicator species (ISA), it is found that the type of *Cynodon dactylon* grasslands has in the floristic composition 6 species with indicator value (Table 1).

Most species in this group are oligomesotrophs. Five of the species have a participation (AD_m) of over 0.4%, the highest coverage having the species *Cynodon dactylon* (30.6%). Two species have a coverage between 4.8-8% (*Artemisia austriaca* - 8% and *Achillea pannonica* - 4.8%), and 2 species have a coverage between 1-3% (*Plantago lanceolata* - 2.2% and *Bromus tectorum* - 1.4%). Only one species has a minimum cover of only 0.4% (*Carduus nutans*). The highest indicator value (INDVAL) has the species *Cynodon dactylon* (85,7), followed by *Achillea pannonica* (59) and *Plantago lanceolata* (51,6). The lowest indicator value, below 50%, the species have its *Artemisia austriaca* (48,7), *Bromus tectorum* (32,8) and *Carduus nutans* (18). The low indicator value of these species is determined by the presence of the species and in the other phytocenoses. The indicative value of these species is given, on the one hand by the maximum constancy (K), and on the other hand by the highest coverage in these phytocenoses. For example, the species *Cynodon dactylon* has a high indicator value for this phytocenosis because it has the highest coverage (30,6%). On the base of some correlations resulted from anterior research regarding the dynamics of this species had resulted that it has a great capacity to explore the existent resources and is able to adapt to the existent climatic conditions (low rainfall amount during the vegetation season, high temperatures, deficient management. The higher and higher presence and coverage rate of these grasses in grasslands from a year to other suggests a certain trajectory of transformation of these grasslands from mesophytic to xero-mesophytic (Durău et al., 2021). The type of grassland *Bothriochloa ischaemum – Festuca valesiaca* has in the floristic composition 4 species with indicator value (Table 1). Most species in this group are oligotrophic. The highest share (AD_m) in the floristic composition has the species *Bothriochloa ischaemum* (40,9%). The other species have a participation between 1.5 - 2.5% (*Teucrium chamaedrys* – 2,1%; *Sanguisorba minor* – 1,5% and *Teucrium polium* – 1,5%). Within the second type of grasslands, the species has the highest indicator value (INDVAL) *Bothriochloa ischaemum* (71,5), *Sanguisorba minor* (57,4) and *Teucrium chamaedrys* (51,8). The lowest indicator value, below 50%, is the species *Teucrium polium* (36). In intensely grazed areas or deforested areas, there are plant associations typical for secondary (semi-natural) grasslands (*Artemisio austriacae-Poëtum bulbosae*, *Taraxaco serotini-Bothriochloëtum ischaemi*; Tupu, 2010; Urziceanu et al., 2021).

In the floristic composition of the type of grasslands *Festuca valesiaca* there are 5 species with indicator value (Table 1). Most species in this group are oligotrophic. The species has the highest participation (AD_m) is *Festuca valesiaca* (39%), and 3 species have a participation between 1-2.5% (*Eryngium campestre* – 2,3%, *Crataegus monogyna* – 1,9% and *Herniaria glabra* – 1%). Only one species has a minimum coverage of only 0.9% (*Centaurea diffusa*). The highest indicator value (INDVAL) it has a species *Centaurea diffusa* (56). The lowest indicator value, below 50%, is the species *Herniaria glabra* (44,2), *Festuca valesiaca* (39,4), *Crataegus monogyna* (34,2) and *Eryngium campestre* (34,1). The type of graslsands *Festuca valesiaca* – *Stipa capillata* has 4 species with indicator value (Table 1). Most species in this group are oligotrophic. The species has the highest participation (AD_m) *Stipa capillata* (19,5%), and the other species have a minimum weight, below 0,9% (*Agropyron cristatus* – 0,5%, *Potentilla erecta* – 0,4% and *Alyssum alyssoides* – 0,3%). The highest indicator value in the floristic composition of this type of grasslands (INDVAL) it has a species *Stipa capillata* (85,5). The lowest indicator value, below 50%, is the species A*gropyron cristatus* (30,8), *Alyssum alyssoides* (23,1) and *Potentilla erecta* (23,1). The habitat 62C0* Stepe ponto sarmatice is dominated by vegetal associations with *Festuca valesiaca*, *Chrysopogon gryllus*, *Dichanthium ischaemum*, *Stipa capillata*, *Stipa tirsa* (Anastasiu et al., 2008).

Table 1. Species with indicative value

No. crt.	Species	Type of grassland	INDVAL	Average	Dev. std.	Semnif.	AD_m
1.	*Bromus tectorum*	1	32.8	10.3	6.02	*	1.4
2.	*Cynodon dactylon*	1	85.7	28.6	7.97	**	30.6
3.	*Achillea pannonica*	1	59.0	20.1	7.60	*	4.8
4.	*Artemisia austriaca*	1	48.7	26.9	4.65	**	8.0
5.	*Carduus nutans*	1	18.0	8.4	5.29	*	0.4
6.	*Plantago lanceolata*	1	51.6	22.9	6.10	**	2.2
7.	*Bothriochloa ischaemum*	2	71.5	33.4	4.51	**	40.9
8.	*Sanguisorba minor*	2	57.4	21.7	6.26	**	1.5
9.	*Teucrium chamaedrys*	2	51.8	22.6	6.26	*	2.1
10.	*Teucrium polium*	2	36.0	23.0	5.76	*	1.5
11.	*Festuca valesiaca*	3	39.4	28.3	1.59	**	39.0
12.	*Centaurea diffusa*	3	56.0	17.7	7.11	**	0.9
13.	*Crataegus monogyna*	3	34.2	17.8	6.86	*	1.9
14.	*Eryngium campestre*	3	34.1	28.7	2.92	*	2.3
15.	*Herniaria glabra*	3	44.2	21.0	6.70	*	1.0
16.	*Agropyron cristatus*	4	30.8	10.2	5.84	*	0.5
17	*Stipa capillata*	4	85.5	26.8	6.72	**	19.5
18.	*Alyssum alyssoides*	4	23.1	9.2	5.43	*	0.3
19.	*Potentilla erecta*	4	23.1	9.2	5.52	*	0.4

Note: ***1 – type*** *Cynodon dactylon****; 2- type*** *Bothriochloa ischaemum – Festuca valesiaca****, 3- type*** *Festuca valesiaca;* ***4- type*** *Festuca valesiaca – Stipa capillata****, INDVAL*** *– indicator value;* ***Dev. Std*** *- standard deviation;* ***Semnif.****: *** p<0.001; ** p<0.01; * p<0.05;* ***ns*** *– insignificant;* ***ADm*** *– abundance – dominance – average.*

The type of grassland *Cynodon dactylon*

In the floristic composition of the *Cynodon dactylon* grasslands type, the Poaceae have the highest coverage in the floristic composition, with an average participation of 44%, and the plants from the Fabaceae family have a coverage of 1%. Plants from Other Families Botanical (OFB) are present in a proportion of 27.8%, and species from the family Cyperaceae - Juncaceae are missing. Among the Poaceae, in addition to the dominant species there are also: *Festuca valesiaca*, with 5.4% coverage in the floristic composition, but also *Bothriochloa ischaemum*, with a coverage of 4.2%. Fabaceae are represented by 4 species, of which *Medicago lupulina* has the highest coverage (0.4%). Among the plants from other botanical families, we have the following species: *Artemisia austriaca* - 8%, *Thymus pannonicus* - 5% (Table 2).

The ecological spectrum of the *Cynodon dactylon* grass type is xerophilous (Up = 2.9), weakly alkaline (Rp = 7.9) and oligomesotrophic (Np = 4.2). is xerophilous (Up = 2.9), weakly alkaline (Rp = 7.9) and oligomesotrophic (Np =

4.2). Agronomic spectrum of grassland type *Cynodon dactylon* it is moderately tolerant to mowing (Cp = 4.2), medium tolerant to grazing (Pp = 5.8) and moderately tolerant to crushing (Sp = 3.8). Pastoral value is 4.4 the graslands is mediocre category and supports 0.41-0.60 LU / ha (Table 3).

Table 2. The floristic composition of the type of graslands *Cynodon dactylon* and the exigency of species for ecological, agronomic and anthropogenic factors

Ecological factors					Agronomic factors				Anthropogenic factors			Species	AD_m	K
B	T	H	R	N	M	G	C	SO	VF	H	UR			
H	7	3	X	3	-	-	-	n	3	3-4	2	*Bothriochloa ischaemum*	4.2	V
												Bromus tectorum	1.4	II
H	7	3	X	5	-	-	-	n	5	3-6	4	*Cynodon dactylon*	30.6	V
H	7	2	8	2	7	7	7	n	4	2-3	1	*Festuca valesiaca*	5.4	V
												Koeleria splendens	0.4	I
HT	5	5	x	7	8	8	8	n	9	3-5	3	*Lolium perenne*	0.2	I
H	7	3	X	1	-	-	-	n	7	2-4	2	*Poa bulbosa*	1.4	II
H	7	2	8	2	2	3	3	n	3	2-4	1	*Stipa capilata*	0.4	I
												POACEAE	**44**	
HA	5	6	7	6	5	2	3	n	7	2-4	2	*Lathyrus pratensis*	0.2	I
HS	5	4	8	x	7	4	6	n	8	3-5	3	*Medicago lupulina*	0.4	I
TT	5	4	x	6	6	4	4	n	7	3-4	2	*Trifolium campestre*	0.2	I
HA	x	5	x	6	6	1	2	n	6	3-4	2	*Vicia cracca*	0.2	I
												FABACEAE	**1**	
												Achillea pannonica	4.8	IV
HRs	6	4	8	4	3	4	3	n	3	2-3	2	*Agrimonia eupatoria*	0.2	I
												Ajuga chamaepitys	0.2	I
H	7	3	8	4	2	6	1	n	2	4-6	3	*Artemisia austriaca*	8	V
H	7	3	8	3	3	3	3	n	6	2-3	1	*Asperula cynanchica*	0.2	I
												Berteroa incana	0.6	I
HT	x	3	8	7	3	7	3	n	3	3-4	2	*Carduus nutans*	0.4	I
HRs	6	4	8	5	4	5	5	n	5	3-5	3	*Cichorium intybus*	0.4	I
												Cruciata pedemontana	0.2	I
H	7	3	8	4	2	4	3	n	2	2-4	2	*Eryngium campestre*	1.4	V
												Euphorbia sequeriana	0.4	II
												Galium humifusum	1	II
												Herniaria glabra	0.2	I
												Marrubium peregrinum	1	I
HR	x	x	x	x	7	6	6	n	6	2-4	3	*Plantago lanceolata*	2.2	V
H	X	2	5	1	3	4	4	n	4	2-4	2	*Potentilla argentea*	0.8	I
												Teucrium chamaedrys	0.8	I
												Thymus pannonicus	5	V
												OFB	**27.8**	

Note: *B – bioform, T – temperature, H – humidity, R – soil reaction, N – trophicity, M – mowing tolerance, G – grazing tolerance, C – crushing tolerance, VF – forage value, H – hemerobia, UR – urbanophilia, SO – category sozological; AD_m – abundance - dominance - average, K – species constancy, OFB - other botanical families.*

In the phytocenosis of the *Cynodon dactylon* type there are 2 species of harmful animal products (*Artemisia austriaca* şi *Eryngium campestre*), 4 species with low forage value and harmful to grassland vegetation (*Bothriochloa ischaemum*, *Stipa capillata*, *Agrimonia eupatoria* şi *Carduus nutans*), but also 2 species without fodder value (*Festuca valesiaca* şi *Potentilla argentea*), with a total participation of 6,2% in the floristic composition. There are also 5

medium forage species with a total coverage of 33,6%, 4 good fodders (*Poa bulbosa*, *Lathyrus pratensis*, *Medicago lupulina* and *Trifolium campestre*), with a total coverage of 2,2% in the floristic composition, and the excellent fodder is represented by a single species *Lolium perenne*, with 0,2% coverage (Table 3).

Table 3. Ecological and agronomic spectrum of grassland type *Cynodon dactylon*

Ecological indices	**Ecological spectrum**										**VIMnp**
	1	2	3	4	5	6	7	8	9	x	VIMp
Hnp	0	3	7	4	2	1	0	0	0	1	3.5
Hp	0	6.6	46.2	1.2	0.4	0.2	0	0	0	2.2	2.9
Rnp	0	0	0	0	1	0	1	9	0	7	7.6
Rp	0	0	0	0	0.8	0	0.2	16.8	0	39	7.9
Nnp	2	2	2	3	2	3	2	0	0	2	4.1
Np	2.2	5.8	4.4	9.6	31	0.6	0.6	0	0	2.6	4.2
Agronomic indicators	**Agronomic spectrum**										**VIMnp**
	1	2	3	4	5	6	7	8	9	x	VIMp
Mnp	0	3	4	1	1	2	3	1	0	0	4.5
Mp	0	9.8	1.6	0.4	0.2	0.4	8	0.2	0	0	4.2
Gnp	1	1	2	5	1	2	2	1	0	0	4.5
Gp	0.2	0.2	0.6	3	0.4	10.2	5.8	0.2	0	0	5.8
Cnp	1	1	6	2	1	2	1	1	0	0	4.1
Cp	8	0.2	2.8	1	0.4	2.6	5.4	0.2	0	0	3.8
VFnp	0	2	4	2	2	3	3	1	1	0	5.0
VFp	0	9.4	5.2	6.2	31	2.6	1.8	0.4	0.2	0	4.4

Note: *U – humidity, R - soil reaction, N – trophicity, C – mowing, G – grazing, C – crushing, VF – forage value, np - unweighted (depending on the number of species), p- weighted (depending on species coverage)*

Bothriochloa ischaemum - Festuca valesiaca type

In the floristic composition of the type of grassland *Bothriochloa ischaemum – Festuca valesiaca*, *Poaceaele* have the largest share in the grass, with an average participation of 61,2%, and the plants in the family *Fabaceae* has a coverage of 0,8%. Plants from other botanical families (OFB) are present with 22,4%, and species in the family *Cyperaceae – Juncaceae* missing. From *Poaceae*, in addition to the dominant species it also appears: *Stipa capillata*, with 1,3% cover in the grassy cover, but also *Cynodon dactylon*, with a coverage of 0,9%. *Fabaceaele* are represented by 5 species, of which they have the largest coverage *Medicago lupulina* (0,3%) and *Medicago falcata* (0,2%). Among the plants from other botanical families, the following species stand out: *Thymus pannonicus*, with a coverage of 4,4% in the vegetal cover, but also *Teucrium chamaedrys*, in proportion of 2.1% (Table 4).

Table 4. The floristic composition of the type of grassland *Bothriochloa ischaemum - Festuca valesiaca* and the exigency of the species to the ecological, agronomic and anthropic factors

Ecological factors					**Agronomic factors**					**Anthropogenic factors**		**Species**	**ADm**	**K**
B	**T**	**U**	**R**	**N**	**M**	**G**	**C**	**SO**	**VF**	**H**	**UR**			
H	7	3	X	3	-	-	-	n	3	3-4	2	*Bothriochloa ischaemum*	40.9	V
TT	6	x	5	3	6	4	5	n	4	4-6	3	*Bromus hordeaceus*	0.2	I
H	7	3	X	5	-	-	-	n	5	3-6	4	*Cynodon dactylon*	0.9	I
H	7	2	8	2	7	7	7	n	4	2-3	1	*Festuca valesiaca*	17.6	V
												Koeleria splendens	0.2	I
H	7	2	8	2	2	3	3	n	3	2-4	1	*Stipa capillata*	1.3	II
												Stipa ucrainica	0.1	I
												POACEAE	**61.2**	
H	7	3	9	2	5	5	4	n	5	1-2	1	*Astragalus onobrychis*	0.1	I
H	5	4	9	3	3	7	-	n	1	2-4	2	*Coronilla varia*	0.1	I

Table 4. The floristic composition of the type of grassland *Bothriochloa ischaemum - Festuca valesiaca* and the exigency of the species to the ecological, agronomic and anthropic factors (*continued*)

Ecological factors					Agronomic factors					Anthropogenic factors			Species	ADm	K
B	T	U	R	N	M	G	C	SO	VF	H		UR			
													Lathyrus sphaericus	0.1	I
H	6	3	9	3	5	2	2	n	7	2-4	2		*Medicago falcata*	0.2	I
HS	5	4	8	x	7	4	6	n	8	3-5	3		*Medicago lupulina*	0.3	I
													FABACEAE	**0.8**	
													Achillea coarctata	0.3	I
													Achillea pannonica	0.2	I
													Adonis flammea	0.1	I
HRs	6	4	8	4	3	4	3	n	3	2-3	2		*Agrimonia eupatoria*	0.2	I
													Ajuga chamaepitys	0.3	II
													Anthemis ruthenica	0.1	I
H	7	3	8	4	2	6	1	n	2	4-6	3		*Artemisia austriaca*	1.1	II I
H	7	3	8	3	3	3	3	n	6	2-3	1		*Asperula cynanchica*	0.3	I
													Carpinus orientalis	0.3	I
													Centaurea micranthos	0.1	I
													Centaurea diffusa	0.1	I
													Chondrila juncea	0.1	I
													Convolvulus cantabricus	1.5	II
Phn	5	4	8	3	1	5	9	n	3	2-4	2		*Crataegus monogyna*	0.6	II
													Cruciata pedemontana	0.7	I
H	7	3	8	4	2	4	3	n	2	2-4	2		*Eryngium campestre*	1.5	V
													Euphorbia sequeriana	0.3	II
H	5	3	8	3	3	4	4	n	4	2-3	2		*Fragaria viridis*	0.7	II
HS	x	4	x	2	4	7	7	n	4	2-4	2		*Hieracium pilosella*	0.3	I
													Marrubium peregrinum	0.3	I
HR	x	x	x	x	7	6	6	n	6	2-4	3		*Plantago lanceolata*	1.3	V
H	X	2	5	1	3	4	4	n	4	2-4	2		*Potentilla argentea*	1.7	V
													Potentilla pedata	0.1	I
HRs	6	4	8	3	4	4	5	n	5	-	-		*Sanguisorba minor*	1.5	V
													Sedum hildebrandti	0.3	I
													Taraxacum serotinum	0.3	I
													Teucrium chamaedrys	2.1	V
													Teucrium polium	1.5	I V
													Thymus pannonicus	4.4	V
													Valerianella lacusta	0.1	I
													OFB	**22.4**	

Note: *B – bioform, T – temperature, H – humidity, R – soil reaction, N – trophicity, M – mowing tolerance, G – grazing tolerance, C – crushing tolerance, VF – forage value, H – hemerobia, UR – urbanophilia, SO – category sozological; ADm – abundance - dominance - average, K – species constancy, OFB - other botanical families.*

Following the ecological spectra, it is found that the phytocenosis of the type *Bothriochloa ischaemum – Festuca valesiaca* is xerophilous (Up=2,7), weakly alkaline (Rp=7,8) and oligotrophic (Np=2,7). The agronomic spectrum of the type *Bothriochloa ischaemum – Festuca valesiaca* it is medium tolerant to mowing (Mp = 5.6), medium tolerant to grazing (Gp = 6.0) and medium tolerant to crushing (Cp = 5.9). Pastoral value (VF) is 3.4, which means that the grassland falls into the III class, degraded category and supports a load of 0.21-0.40 LU / ha (Table 5). Type of

Bothriochloa ischaemum – Festuca valesiaca there is a toxic species (*Coronilla varia*), 2 species harmful to animal products (*Artemisia austriaca and Eryngium campestre*), 4 species with low forage value and harmful to grassland vegetation (*Bothriochloa ischaemum, Stipa capillata, Agrimonia eupatoria* and *Crataegus monogyna*), ballast species (*Bromus hordeaceus, Festuca valesiaca, Fragaria viridis* s.a.), with a total participation of 20.5% in the grassy cover.

Table 5. Ecological and agronomic spectrum of grassland type *Bothriochloa ischaemum – Festuca valesiaca*

Ecological indices	**Ecological spectrum**										**VIMnp**
	1	2	3	4	5	6	7	8	9	x	VIMp
Unp	0	3	8	6	0	0	0	0	0	2	3.2
Up	0	20.6	45.7	3.0	0	0	0	0	0	1.5	2.7
Rnp	0	0	0	0	2	0	0	10	3	4	7.8
Rp	0	0	0	0	1.9	0	0	25.1	0.4	43.4	7.8
Nnp	1	4	8	3	1	0	0	0	0	2	2.9
Np	1.7	19.3	44.5	2.8	0.9	0	0	0	0	1.6	2.7
Agronomic indicators	**Agronomic spectrum**										**VIMnp**
	1	2	3	4	5	6	7	8	9	x	VIMp
Mnp	1	3	5	2	2	1	3	0	0	0	3.9
Mp	0.6	3.9	3	1.8	0.3	0.2	19.2	0	0	0	5.6
Gnp	0	1	2	7	2	2	3	0	0	0	4.6
Gp	0	0.2	1.6	6.1	0.7	2.4	18	0	0	0	6.0
Cnp	1	1	4	3	2	2	2	0	1	0	4.5
Cp	1.1	0.2	3.3	2.5	1.7	1.6	17.9	0	0.6	0	5.9
VFnp	1	2	4	5	3	2	1	1	0	0	4.2
VFp	0.1	2.6	43	20.5	2.5	1.6	0.2	0.3	0	0	3.4

Note: *U – humidity, R - soil reaction, N – trophicity, M – mowing, G – grazing, C – crushing, VF – forage value, np - unweighted (depending on the number of species), p- weighted (depending on species coverage).*

Type of *Festuca valesiaca*

In the floristic composition of the *Festuca valesiaca* type of grassland, the Poaceae have the highest share in the grassy cover, with an average participation of 51.6%, and the plants from the Fabaceae family have a coverage of 0.5%. Plants from other botanical families (OFB) are present in proportion of 24.6%, and species from the family Cyperaceae - Juncaceae are missing. Among the Poaceae, in addition to the dominant species, it also appears: *Bothriochloa ischaemum*, with 6,4% cover in the grassy cover, but also *Cynodon dactylon*, with a coverage of 3,1%. *Fabaceaele* are represented by 4 species, of which it has the largest coverage *Medicago lupulina* (0,2%). Among the plants from other botanical families, the following species stand out: *Thymus pannonicus*, with a coverage of 4.5% in the floristic composition, but also *Artemisia austriaca* - 4% (Table 6).

Table 6. The floristic composition of the *Festuca valesiaca* grassland type and the exigency of the species to the ecological, agronomic and anthropic factors

Ecological factors				**Agronomic factors**					**Anthropogenic factors**			**Species**	**AD m**	**K**
B	**T**	**H**	**R**	**N**	**M**	**H**	**C**	**SO**	**VF**	**H**	**UR**			
H	7	3	X	3	-	-	-	n	3	3-4	2	*Bothriochloa ishaemum*	6.4	V
												Bromus riparius	0.1	I
H	7	3	X	5	-	-	-	n	5	3-6	4	*Cynodon dactylon*	3.1	V
												Festuca calligera	0.1	I
H	7	2	8	2	7	7	7	n	4	2-3	1	*Festuca valesiaca*	39	V
H	7	2	7	3	-	-	-	n	4	2-3	1	*Melica ciliata*	0.1	I
H	7	3	X	1	-	-	-	n	7	2-4	2	*Poa bulbosa*	1.2	III
H	7	2	8	2	2	3	3	n	3	2-4	1	*Stipa capillata*	1.6	IV
												POACEAE	**51.6**	
HS	5	4	8	x	7	4	6	n	8	3-5	3	*Medicago lupulina*	0.2	I
												Medicago minima	0.1	I

Table 6. The floristic composition of the *Festuca valesiaca* grassland type and the exigency of the species to the ecological, agronomic and anthropic factors *(continued)*

Ecological factors					Agronomic factors				Anthropogenic factors			Species	ADm	K
B	T	H	R	N	M	H	C	SO	VF	H	UR			
HT												*Onobrychis viciifolia*	0.1	I
												Trifolium arvense	0.1	I
												FABACEAE	**0.5**	
												Achillea coarctata	0.1	I
												Achillea pannonica	0.7	II
HRs	6	4	8	4	3	4	3	n	3	2-3	2	*Agrimonia eupatoria*	0.1	I
												Anthemis ruthenica	0.1	I
H	7	3	8	4	2	6	1	n	2	4-6	3	*Artemisia austriaca*	4	IV
H	7	3	8	3	3	3	3	n	6	2-3	1	*Asperula cynanchica*	0.1	I
HT	x	3	8	7	3	7	3	n	3	3-4	2	*Carduus nutans*	0.1	I
												Centaurea diffusa	0.9	III
												Chondrila juncea	0.5	III
HRs	6	4	8	5	4	5	5	n	5	3-5	3	*Cichorium intybus*	0.3	I
GA	6	x	7	x	4	4	4	n	5	3-6	3	*Convolvulus arvensis*	0.1	I
Phn	5	4	8	3	1	5	9	n	3	2-4	2	*Crataegus monogyna*	1.9	III
												Dianthus nardiformis	0.4	I
TT	7	X	X	4	2	3	2	n	4	3-5	3	*Echium vulgare*	0.1	I
TT	5	3	X	X	-	-	-	n	4	4-5	3	*Erodium cicutarium*	0.1	I
H	7	3	8	4	2	4	3	n	2	2-4	2	*Eryngium campestre*	2.3	V
												Euphorbia nicaeensis	0.4	I
												Euphorbia sequeriana	0.4	I
H	5	3	8	3	3	4	4	n	4	2-3	2	*Fragaria viridis*	0.2	I
												Galium humifusum	0.4	II
												Herniaria glabra	1	IV
												Hieracium bauhinii	0.1	I
HS	x	4	x	2	4	7	7	n	4	2-4	2	*Hieracium pilosella*	0.1	I
												Inula oculus-christi	0.3	I
HR	x	x	x	x	7	6	6	n	6	2-4	3	*Plantago lanceolata*	0.6	II
H	X	2	5	1	3	4	4	n	4	2-4	2	*Potentilla argentea*	1.4	IV
												Potentilla pedata	0.1	I
												Reseda lutea	0.1	I
Phn - ChL	6	3	7	2	1	4	9	n	3	-	-	*Rosa pimpinellifolia*	0.1	I
HRs	6	4	8	3	4	4	5	n	5	-	-	*Sanguisorba minor*	0.6	II
												Scleranthus annuus	0.1	I
												Scleranthus perennis	0.1	I
												Sedum hildebrandti	0.7	II
												Taraxacum serotinum	0.1	I
												Teucrium chamaedrys	0.8	III
												Teucrium polium	0.6	II
												Thymus pannonicus	4.5	V
												Thymus zygioides	0.1	I
												OFB	**24.6**	

Note: *B – bioform, T – temperature, H – humidity, R – soil reaction, N – trophicity, M – mowing tolerance, G – grazing tolerance, C – crushing tolerance, VF – forage value, H – hemerobia, UR – urbanophilia, SO – category sozologică; ADm – abundance - dominance - average, K – species constancy, OFB - other botanical families.*

Following the ecological spectra, it is found that the phytocenosis of the *Festuca valesiaca* type is xerophilous (Hp = 2.4), weakly alkaline (Rp = 7.9) and oligotrophic (Np = 2.5). The agronomic spectrum (*Festuca valesiaca* type) is medium tolerant to mowing (Mp = 5.8), medium tolerant to grazing (Gp = 6.4) and medium tolerant to crushing (Cp = 6.1). VF (pastoral value) is 3.8, the graslands falls into the third class, degraded category and supports a load of 0.21-0.40 LU / ha (Table 7). In the phytocenosis of the *Festuca valesiaca* type there are 2 species harmful to animal products (*Artemisia austriaca and Eryngium campestre*), 6 species with low forage value and harmful to grassland vegetation (*Bothriochloa ischaemum, Stipa capillata, Agrimonia eupatoria* s.a.), as well as 7 species *Festuca valesiaca*, *Melica ciliata, Echium vulgare* s.a.), with a total coverage of 41% in the grassy cover. There are also 6 medium forage species with a total coverage of 4.8%, 2 good forage species (*Poa bulbosa and Medicago lupulina*), with a total participation of 1.4% in the vegetal cover, and the excellent forages are missing from the grassy cover (Table 7).

Table 7. Ecological and agronomic spectrum of grassland type *Festuca valesiaca*

Ecological indices	**Spectru ecologic**										**VIMnp**
	1	2	3	4	5	6	7	8	9	x	VIMp
Hnp	0	4	10	6	0	0	0	0	0	3	3.1
Hp	0	42.1	17.6	3.2	0	0	0	0	0	0.8	2.4
Rnp	0	0	0	0	1	0	3	12	0	7	7.6
Rp	0	0	0	0	1.4	0	0.3	50.4	0	11.6	7.9
Nnp	2	4	6	4	2	0	1	0	0	4	3.2
Np	2.6	40.8	9.3	6.5	3.4	0	0.1	0	0	1.0	2.5
Agronomic indicators.	**Agronomic spectrum**										**VIMnp**
	1	2	3	4	5	6	7	8	9	x	VIMp
Mnp	2	4	5	4	0	0	3	0	0	0	3.4
Mp	2	8	1.9	1.1	0	0	39.8	0	0	0	5.8
Gnp	0	0	3	8	2	2	3	0	0	0	4.7
Gp	0	0	1.8	5	2.2	4.6	39.2	0	0	0	6.4
Cnp	1	1	5	3	2	2	2	0	2	0	4.7
Cp	4	0.1	4.2	1.7	0.9	0.8	39.1	0	2	0	6.1
VFnp	0	2	6	7	4	2	1	1	0	0	4.2
VFp	0	6.3	10.2	41	4.1	0.7	1.2	0.2	0	0	3.8

Note: *U – humidity, R - soil reaction, N – trophicity, M – mowing, G – grazing, C – crushing, VF – forage value, np - unweighted (depending on the number of species), p- weighted (depending on species coverage).*

The type of grassland *Festuca valesiaca – Stipa capillata*

In the floristic composition of the type of *Festuca valesiaca - Stipa capillata*, the Poaceae have the highest share in the grassy cover, with an average participation of 65.7%, and the plants of the Fabaceae family have a coverage of 0.9%. Plants from other botanical families (OFB) are present in a proportion of 19.4%, and species from the family Cyperaceae - Juncaceae are missing. Among the *Poaceae*, in addition to the dominant species, it also appears: *Bothriochloa ischaemum* with 5,7% cover in the grassy cover, but also *Cynodon dactylon*, with a coverage of 1,1%. *Fabaceaele* are represented by 5 species, of which the largest share is *Medicago falcata* (0,3%). Among the plants from other botanical families, we have: *Artemisia austriaca*, with a coverage of 3,3% in the vegetal cover, but also *Thymus pannonicus* - 3,1% (Table 8).

Table 8. The floristic composition of the type of grassland *Festuca valesiaca – Stipa capillata* and the exigency of the species to the ecological, agronomic and anthropic factors

Ecological factors				**Agronomic factors**						**Anthropogenic factors**		**Species**	**AD_m**	**K**
B	**T**	**H**	**R**	**N**	**M**	**G**	**C**	**SO**	**VF**	**H**	**UR**			
												Agropyron cristatus	0.5	II
H	7	3	X	3	-	-	-	n	3	3 - 4	2	*Bothriochloa ischaemum*	5.7	V
TT	6	x	5	3	6	4	5	n	4	4 - 6	3	*Bromus hordeaceus*	0.3	I
												Bromus tectorum	0.3	I

Table 8. The floristic composition of the type of grassland *Festuca valesiaca – Stipa capillata* and the exigency of the species to the ecological, agronomic and anthropic factors *(continued)*

Ecological factors					Agronomic factors					Anthropogenic factors		Species	AD_m	K
B	T	H	R	N	M	G	C	SO	VF	H	UR			
	7	3	X	5	-	-	-	n	5	3 - 6	4	*Cynodon dactylon*	1.1	II
H	7	2	8	2	7	7	7	n	4	2 - 3	1	*Festuca valesiaca*	37	V
												Koeleria splendens	0.5	II
H	7	3	X	1	-	-	-	n	7	2 - 4	2	*Poa bulbosa*	0.8	II
H	7	2	8	2	2	3	3	n	3	2 - 4	1	*Stipa capillata*	19.5	V
												POACEAE	**65.7**	
												Astragalus glaucus	0.1	I
H	7	3	9	2	5	5	4	n	5	1 - 2	1	*Astragalus onobrychis*	0.1	I
H	6	3	9	3	5	2	2	n	7	2 - 4	2	*Medicago falcata*	0.3	I
HS	5	4	8	x	7	4	6	n	8	3 - 5	3	*Medicago lupulina*	0.2	I
HT												*Onobrychis viciifolia*	0.2	I
												FABACEAE	**0.9**	
												Achillea coarctata	0.3	I
												Achillea pannonica	0.8	II
												Alyssum alyssoides	0.3	I
												Alyssum hirsutum	0.2	I
												Anthemis ruthenica	0.1	I
H	7	3	8	4	2	6	1	n	2	4 - 6	3	*Artemisia austriaca*	3.3	IV
H	7	3	8	3	3	3	3	n	6	2 - 3	1	*Asperula cynanchica*	0.1	I
												Berteroa incana	0.1	I
												Centaurea diffusa	0.1	I
												Chondrila juncea	0.3	I
HRs	6	4	8	5	4	5	5	n	5	3 - 5	3	*Cichorium intybus*	0.2	I
												Convolvulus cantabricus	0.6	I
Phn	5	4	8	3	1	5	9	n	3	2 - 4	2	*Crataegus monogyna*	0.4	I
												Dianthus nardiformis	0.4	I
												Echinops ruthenicus	0.1	I
H	7	3	8	4	2	4	3	n	2	2 - 4	2	*Eryngium campestre*	1.2	IV
												Euphorbia glareosa	0.2	I
												Euphorbia sequeriana	0.8	II
H	5	3	8	3	3	4	4	n	4	2 - 3	2	*Fragaria viridis*	0.1	I
												Galium humifusum	0.4	II
												Haplophyllum suaveolens	0.1	I
												Herniaria glabra	0.5	II
												Inula oculus-christi	0.5	I
												Marrubium peregrinum	0.2	I
HR	x	x	x	x	7	6	6	n	6	2 - 4	3	*Plantago lanceolata*	0.2	I
H	X	2	5	1	3	4	4	n	4	2 - 4	2	*Potentilla argentea*	1.1	IV
HT	x	x	x	2	3	4	5	n	5	2 - 3	1	*Potentilla erecta*	0.4	I
												Potentilla pedata	0.3	I
												Salvia nutans	0.1	I
HRs	6	4	8	3	4	4	5	n	5	-	-	*Sanguisorba minor*	0.3	I
HRs	5	7	x	3	5	3	2	n	6	3 - 5	1	*Sanguisorba officinalis*	0.1	I
												Sedum hildebrandti	0.4	I
												Teucrium chamaedrys	0.1	I
												Teucrium polium	1.3	IV
												Thymus pannonicus	3.1	IV
												Thymus zygioides	0.6	I
												Xeranthemum annum	0.1	I
												OFB	**19.4**	

Note: *B – bioform, T – temperature, H – humidity, R – soil reaction, N – trophicity, M – mowing tolerance, G – grazing tolerance, C – crushing tolerance, VF – forage value, H – hemerobia, UR – urbanophilia, SO – category sozological; ADm – abundance - dominance - average, K – species constancy, OFB - other botanical families.*

The ecological spectrum of the type *Festuca valesiaca – Stipa capillata* is xerophilous (Up=2,2), weakly alkaline (Rp=7,9) and oligotrophic (Np=2,3). The agronomic spectrum of the type *Festuca valesiaca – Stipa capillata* is environmentally tolerant to mowing (Cp=5,0), medium tolerant to grazing (Pp=5,5) and medium tolerant to crushing (Sp=5,3). Pastoral value (VF) is 3,6, the grassland falls into the III class, the degraded category and supports 0,21-0,40 LU/ha (Table 9). In phytocenosis of the type *Festuca valesiaca – Stipa capillata* there are 2 species harmful to animal products (*Artemisia austriaca* and *Eryngium campestre*), 3 species with low forage value and harmful to grassland vegetation (*Bothriochloa ischaemum*, *Stipa capillata* and *Crataegus monogyna*), as well as 4 species of ballast (*Bromus hordeaceus*, *Festuca valesiaca*, *Fragaria viridis and Potentilla argentea*), with a coverage of 38.5%. There are also 8 medium forage species with a total coverage of 2,5%, 3 good forage species (*Poa bulbosa*, *Medicago falcata* and *Medicago lupulina*), with a total participation of 1.3%, and the excellent fodder is missing from the grassy cover (Table 9).

Table 9. Ecological and agronomic spectrum of grassland type *Festuca valesiaca – Stipa capillata*

Ecological indices	**Ecological spectrum**										**VIMnp**
	1	2	3	4	5	6	7	8	9	x	VIMp
Unp	0	3	9	4	0	0	1	0	0	3	3.3
Up	0	57.6	12.7	1.1	0	0	0.1	0	0	0.9	2.2
Rnp	0	0	0	0	2	0	0	10	2	6	7.7
Rp	0	0	0	0	1.4	0	0	62.3	0.4	8.3	7.9
Nnp	2	4	8	2	2	0	0	0	0	2	2.9
Np	1.9	57.0	7.3	4.5	1.3	0	0	0	0	0.4	2.3
Agronomic indicators	**Agronomic spectrum**										**VIMnp**
	1	2	3	4	5	6	7	8	9	x	VIMp
Mnp	1	3	4	2	3	1	3	0	0	0	4.1
Mp	0.4	24	1.7	0.5	0.5	0.3	37.4	0	0	0	5.0
Gnp	0	1	3	7	3	2	1	0	0	0	4.3
Gp	0	0.3	19.7	3.6	0.7	3.5	37	0	0	0	5.5
Cnp	1	2	3	3	4	2	1	0	1	0	4.4
Cp	3.3	0.4	20.8	1.3	1.2	0.4	37	0	0.4	0	5.3
VFnp	0	2	3	4	5	3	2	1	0	0	4.7
VFp	0	4.5	25.6	38.5	2.1	0.4	1.1	0.2	0	0	3.6

U – humidity, R - soil reaction, N – trophicity, M – mowing, G – grazing, C – crushing, VF – forage value, np - unweighted (depending on the number of species), p- weighted (depending on species coverage).

These grasslands are in a very advanced state of degradation due to inappropriate maintenance and irrational exploitation with very high number of animals, especially sheep, all year round. The pastoral value is low (only 26) and the usable grass production is 2.54 t / ha green mass that supports a very low stocking rate of 0.21 LU / ha (Maruşca, 2019; Maruşca et al., 2020). The pastoral value of the herbaceous layer is considered poor (23.5), the grass production is 2.72 t/ ha useful plant biomass which allows a rather low optimal stocking rate, of only 0.23 Livestock Unit (LU)/ ha for a 185-day grazing season (Maruşca et al., 2020).

CONCLUSIONS

- Following the analysis of the floristic composition, 4 types of meadows resulted, which were individually characterized both from an ecological and agronomic point of view;
- Following the analysis of the floristic composition, there were species with indicative value for each type of grasslands;
- For the type of grassland *Cynodon dactylon*, we identified 6 species with indicative value, for the type *Bothriochloa ischaemum – Festuca valesiaca* we identified 4 species with indicative value, for the type *Festuca valesiaca* we identified 5 species with indicative value, for the type *Festuca valesiaca – Stipa capillata* we identified 4 species with indicative value;
- The pastoral value of the types of grassland is between 0.21-0.40 LU/ha.

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