PRODUCTIVITY ASSESSMENT OF THE CRASNA BASIN GRASSLANDS (CENTRAL MOLDAVIAN PLATEAU)

Teodor MARUȘCA*, Adrian OPREA, Marcela M. DRAGOȘ*, Cristina I. PORR*, Cristina C. COMȘIA***

** Research - Development Institute for Grasslands Braşov*
*** University Al I. Cuza, Iași*
******* **Corresponding author e-mail: (TNR 10)*

Abstract

The Crasna Basin permanent grasslands, located in the Central Moldavian Plateau, located mostly at 200 - 300 m altitude, on relatively flat land or slopes with an inclination of 5 - 35 degrees, have in their composition 95 cormophyte species, an average coverage of 85% with 56% forage species participation in the grass carpet and 29% harmful species, from the productivity point of view the weakest are the associations dominated by Stipa sp. and Botriochloa ischaemum and the highest where Lolium perenne and Beckmania eruciformis dominate, which is proposed to be taken into culture. At the phytosociological alliances (habitats) level, the worst results were assessed for Stipion lessingianae with 0.45 t/ha GMP, 4.7 PV and 460 liters of milk/ha and the best for Cynosurion with 19 t/ha GMP, 85.2 PV and 8350 liters/ha of cow's milk, at a loading of 1.83 LU/ha in 160 days of optimal grazing season. The data obtained as an economic supplement to the study of the vegetation followed by practical applicability, further serve to draw up pastoral arrangements and the proper grasslands management in the study area or other areas with similar vegetation.

Keywords: permanent grassland, green mass production, pastoral value, milk production, animal loading.

INTRODUCTION

The vegetation of permanent grasslands in our country has been studied by numerous geobotanists whose main objective was to determine and classify phytocenoses with less reference to their productivity (BORZA, BOȘCAIU 1965; ANGHEL *et al.*, 1971; CRISTEA *et al.*, 2004; CIOCÂRLAN, 2009 and others).

A first larger work, which presents both the vegetation and the grasslands productivity in our country, was published 6 decades ago (PUȘCARU-SOROCEANU *et al.*, 1963).

Since then, numerous other works describing the vegetation of permanent grasslands have appeared with little data on the production and forage quality necessary for the preparation of pastoral management projects (MARUȘCA *et al.*, 2014).

The particularly valuable geobotanical studies continued to evaluate the grasslands productivity based on floristic survey (MARUȘCA, 2019).

For the Moldova area, based on this new method, so far, the productivity of some grasslands from the plains, hills and mountains has been evaluated, which will serve to know the production of green mass and the pastoral value (MARUȘCA *et al.,* 2021 a, b, 2022, 2023; MARUȘCA, 2022; OPREA, MARUȘCA, 2022).

The present work is a continuation of the evaluation of the Moldova grasslands productivity based on geobotanic floristic surveys.

MATERIAL AND METHOD

The evaluation of grasslands productivity continued with a doctoral thesis entitled "Flora and vegetation of the Crasna Basin (Central Moldavian Plateau)" prepared by biologist Gheorghe Vițalariu under the guidance of Professor Eugen Ghișa, submitted in 1975 at the Faculty of Biology and Geography of "Babeș Bolyai" University " from Cluj Napoca.

From this work, 16 associations of permanent grasslands were evaluated, mostly located between 200 - 300 m altitude with the lower limit at 90 m at the confluence of the Crasna river with the Bârlad river and the 425 m high Cetății Hill, located west of Brădicești.

The older names of classes, orders, alliances and associations in the thesis have been brought up to date with the new ones, indicating synonyms in parentheses (COLDEA 1991, COLDEA *et al.,* 2012).

Overview of grassland associations:

Cl. ***MOLINIO-ARRHENATHERETEA*** R. Tx. 1937 (Syntaxon syn.: Cl. *Molinio-Juncetea* Br.-Bl. ex A. de Bólós y Vayreda 1950, Cl. *Plantaginetea majoris* R. Tx. et Preising in R. Tx. 1950, Cl. *Agrostietea stoloniferae* Görs 1968)

Ord. *MOLINIETALIA CAERULEAE* Koch 1926 (Syntaxon syn.: Ord. *Deschampsietalia* Horvatic 1958)

Al. ***Alopecurion pratensis*** Passarge 1964

1. Ass. ***Ranunculo repenti-Alopecuretum pratensis*** Ellmauer et Mucina in Mucina et al. 1993 (Syntaxon syn.: Ass. *Alopecuretum pratensis* Regel 1925, Ass. *Alopecuretum pratensis* Steffen 1931, Ass. *Alopecuretum* Eggler 1958, Ass. *Alopecuretum pratensis* Nowinski 1928)

Ord.*ARRHENATHERETALIA* R. Tx. 1931 (Syntaxon syn.: Ord. *Arrhenatheretalia* Pawlowski 1928)

Al. ***Cynosurion*** R. Tx. 1947

2. Ass. ***Trifolio-Lolietum perennis*** Krippelova 1967 (Syntaxon syn.: Ass. *Lolio-Trifolietum repentis* Resmeriţă *et al.* 1967, Ass. *Trifolio-Lolietum perennis* (Răvăruţ *et al.* 1956) Krippelova 1967, Resmeriţă *et al.* 1967)

Ord. *POTENTILLO-POLYGONETALIA* R. Tx. 1947 (Syntaxon syn.: Ord. *Agrostietalia stoloniferae* Oberd. in Oberd. *et al.* 1967)

Al. ***Potentillion anserinae*** R. Tx. 1947 (Syntaxon syn.: Al. *Lolio-Potentillion anserinae* R. Tx. 1947, Al. *Eu-Agropyro-Rumicion* Westhoff et Deu Held 1969, Al. *Agrostion stoloniferae* Görs 1966 in Oberd. *et al.* 1967)

3. Ass. ***Agrostietum stoloniferae*** Burduja et al. 1956 (Syntaxon syn.: Ass. *Agrostis stolonifera* Burduja et al. 1956, Ass. *Rorippo-Agrostietum stoloniferae* (Moor 1958) Oberd. et Th. Müller in Th. Müller 1961 p. p., Ass. *Rumici crispi-Agrostietum stoloniferae* Moor 1958 p. p.)
4. Ass. ***Poo sylvicolae-Alopecuretum pratensis*** (Buia et al. 1960) Coldea et al. 2012 (Syntaxon syn.: Ass. *Poëtum silvicolae* Buia *et al.* 1959, Ass. *Poa sylvicola* auct., Ass. *Alopecurus pratensis* Buia *et al.* 1960)
5. Ass. ***Rorippo austriacae-Agropyretum repentis*** (Timar 1947) Tx. 1950 (Syntaxon syn.: Ass. *Agropyretum repentis* Răvăruţ *et al.* 1956, Ass. *Agropyretum repentis* Burduja et al. 1956)

Cl. ***FESTUCO-BROMETEA*** Br.-Bl. et R. Tx. in Br.-Bl. 1949 (Syntaxon syn.: Cl. *Festuco-Brometea* Br.-Bl. et R. Tx. 1943, Cl. *Festuco-Brometea* Br.-Bl. et R. Tx. ex Klika et Hadač 1944)

Ord. *FESTUCETALIA VALESIACAE* Br.-Bl. et R. Tx. ex Br.-Bl. 1949 (Syntaxon syn.: Ord. *Festucetalia valesiacae* Br.-Bl. et R. Tx. 1943)

Al. ***Festucion valesiacae*** Klika 1931 (Syntaxon syn.: Al. *Festuco-Stipion capillatae* Krausch 1959, Al. *Festucion sulcatae* Soó 1929, Al. *Festucion rupicolae* Soó (1940) 1964, Al. *Festucion sulcatae* Soó 1940) Subal. Jurineo arachnoideae-Euphorbinenion nicaeensis Dobrescu et Kovacs 1971 corr. Sârbu, Coldea et Chifu 1993 (Syntaxon syn.: Subal. *Jurineo arachnoideae-Euphorbion stepposae* Dobrescu et Kovács 1971)

6. Ass. ***Taraxaco serotinae-Festucetum valesiacae*** (Burduja *et al.* 1956, Răvăruţ *et al.* 1956) Sârbu, Coldea et Chifu 1999 (Syntaxon syn.: Ass. *Festuca valesiaca* Burduja et al. 1956, Ass. *Medicagini minimae-Festucetum valesiacae sensu auct.*, Ass. *Festucetum valesiacae* Răvăruţ et al. 1956, Ass. *Medicagini-Festucetum valesiacae moldavicum* Bârcă 1973, Ass. *Salvio-Festucetum valesiacae* Dobrescu 1974)
7. Ass. ***Taraxaco serotinae-Bothriochloetum ischaemi*** (Burduja *et al.* 1956) Sârbu, Coldea et Chifu 1999 (Syntaxon syn.: Ass. *Bothriochloa ischaemum* Burduja *et al.* 1956, Ass. *Bothriochloetum ischaemi moldavicum* Dobrescu (1971) 1974, non-Ass. *Bothriochloetum ischaemi* (Krist 1937) I. Pop 1977)
   - subass. *caraganetosum fruticans* Dobrescu et Viţalariu 1973

8. Ass. ***Thymo pannonici-Chrysopogonetum grylli*** Doniţă *et al.* 1992 (Syntaxon syn Ass. *Chrysopogonetum grylli moldavicum* Dobrescu 1971, Bârcă 1973)
9. Ass. ***Artemisio austriacae-Poëtum bulbosae*** I. Pop 1970 (Syntaxon syn.: Ass. *Poa bulbosa* Burduja et al. 1956, Ass. *Poëtum bulbosae* Răvăruţ et al. 1956, Ass. *Artemisietum austriacae* Răvăruţ *et al.* (1956) 1958)
   - subass. *poëtosum bulbosae* (Burduja *et al.* 1956) I. Pop 1970
   - subass. *artemisietosum* (Răvăruţ *et al.* 1956) I. Pop 1970
   - subass. *euphorbietosum stepposae* (Burduja *et al.* 1956) I. Pop 1970
10. Ass. ***Agropyro pectinate-Stipetum capillatae*** (Burduja *et al*. 1956) Chifu et al. 2006 (Syntaxon syn.: Ass. *Stipa capillata* Burduja et al. 1956, Ass. *Stipetum capillatae* sensu auct., Ass. *Stipetum capillatae moldavicum* (Dobrescu 1971) Bârcă 1973)

    Al. ***Stipion lessingianae*** Soó 1947 Subal. *Stipenion lessingianae* (Soó 1947) Coldea *et al.* 2012
11. Ass. ***Jurineo arachnoideae-Stipetum lessingianae*** (Dobrescu 1974) Chifu et al. 2006 (Syntaxon syn.: Ass. *Stipetum lessingianae* Răvăruţ et al. 1956, Ass. *Stipetum lessingianae moldavicum* Dobrescu 1974, Ass. *Stipetum lessingianae* sensu auct.)

Cl. ***PUCCINELLIO-SALICORNIETEA*** Ţopa 1939 (Syntaxon syn.: Cl. *Festuco-Puccinellietea* Soó 1968, Cl. *Crypsietea aculeatae* Vicherek 1973, Cl. *Pucinellio-Salicornietea* Ţopa 1959)

Ord. *PUCCINELLIETALIA* Soó 1947 em. Vicherek 1973 (Syntax. syn.: Ord. *Puccinellietalia* Soó 1940)

Al. ***Puccinellion limosae*** Soó 1953 (Syntax. syn.: Al. *Puccinellion limosae* Klika in Vlach 1937, Al. *Puccinellion limosae* (Klika 1937) Wndbg. l943)

12. Ass. ***Puccinellietum limosae*** Rapaics ex Soó 1936 (Syn.: Ass. *Puccinellia limosa* Rapaics 1927, Ass. *Puccinellietum limosae hungaricum* Soó 1930) Ord. *SCORZONERO-JUNCETALIA GERARDII* Vicherek 1973

    Al. ***Festucion pseudovinae*** Soó 1933 (Syntaxon syn.: Al. *Statici-Artemision* Ţopa 1939)
13. Ass. ***Cynodonto-Festucetum pseudovinae*** Soó 1957 (Syntaxon syn.: Ass. *Artemisio-Festucetum pseudovinae* (Magyar 1928) Soó 1945)
    - subass. *camphorosmetosum monspeliacae* Viţalariu 1976

    Al. ***Scorzonero-Juncion gerardii*** (Wendelberger 1943) Vicherek 1973 (Syntaxon syn.: *Al. Juncion gerardi* Wendelbg. 1943)
14. Ass. ***Astero tripoli-Juncetum gerardii*** Šmarda 1953 (Syntaxon syn.: Ass. *Scorzonero parviflorae-Juncetum gerardii* (Wenzl 1984) Wendelberger 1943, Ass. *Juncetum gerardi* (Wenzl 1934)

15. Ass. ***Agrostio stoloniferae-Caricetum distantis*** Rapaics ex Soó 1938 (Syntaxon syn.: Ass. *Caricetum distantis-vulpinae* Todor 1947)
Al. ***Beckmannion eruciformis*** Soó 1933
16. Ass. ***Beckmannietum eruciformis*** Rapaics ex Soó 1930 (Syntaxon syn.: Ass. *Beckmannietum eruciformis* Rapaics 1916, Ass. *Agrostio-Beckmannietum eruciformis* (Rapaics 1916) Soó 1933)

For the evaluation of the green mass production and pastoral value, the working method based on floristic surveys of the described grassland associations was used (MARUȘCA, 2019).

The duration of the grazing season was reduced to 160 days, due to the excessive drought conditions in the study area (MARUȘCA, 2001).

When evaluating the milk production that can be obtained under the conditions of rational grazing, the coefficients obtained based on long-term experiments with dairy cows were taken into account (MARUȘCA *et al.* 2018, 2020).

RESULTS AND DISCUSSIONS

To evaluate the grasslands productivity in the study area, 16 grassland associations with 213 floristic surveys were analyzed (Table 1).

In their vast majority, these grasslands are located on flat lands, followed by those on the slopes of hills with slopes of 5 - 35 degrees and predominantly western.

Regarding the flora of these grasslands, it is noted that it is particularly rich, with an average of 95 species of cormophytes, on survey average.

The most species were found in the dry hill grassland associations *Taraxaco serotinae - Botriochloetum ischaemi* (212 specimens), *Taraxaco serotinae - Festucetum valesiacae* (211) and *Agropyro pectinate - Stipetum capillatae* (145).

The fewest cormophyte species were recorded in grassland associations located on saline soils with temporary excess moisture: *Agrostio stoloniferae - Caricetum distantis* (48), *Astero Tripoli - Juncetum gerardii* (50) and *Puccinellietum limosae* (55 species).

The average degree coverage was 85%, from 73% for the degraded grassland with the *Taraxaco serotinae - Botriochloetum ischaemi* association, to 95% in the *Beckmannietum eruciformis* association on saline soils.

Table 1

General data on localization and vegetation of grassland phytocenoses

No.	Grassland Associations	No. of surveys	Exposition	Slope (grade)	Cormophyte (no)	Coverage (%)
	Al. ***Alopecurion pratensis***					
1	*Ranunculo repenti-Alopecuretum pratensis*	8	Flat (F)	0-10	67	86
	Al. ***Cynosurion***					
2	*Trifolio-Lolietum perennis*	10	F, SW, W	0	76	92
	Al. ***Potentillion anserinae***					
3	*Agrostietum stoloniferae*	10	Flat	0	72	89
4	*Poo sylvicolae-Alopecuretum pratensis*	11	Flat	0	71	90
5	*Rorippo austriacae-Agropyretum repentis*	12	Flat	15-35	68	93
	Al. ***Festucion valesiacae***					
6	*Taraxaco serotinae-Festucetum valesiacae*	32	W, SW	5-30	211	83
7	*Taraxaco serotinae-Bothriochloetum ischaemi*	26	NW, NE, E	5-20	212	73
8	*Thymo pannonici-Chrysopogonetum grylli*	11	W, SW, S,SE	5-20	129	86
9	*Artemisio austriacae-Poëtum bulbosae*	18	W, SW, NV	5-20	117	79
10	*Agropyro pectinate-Stipetum capillatae*	15	W, SW, SE,	5-30	145	82
	Al. ***Stipion lessingianae***					
11	*Jurineo arachnoideae-Stipetum lessingianae*	8	W,SW, SE	0	89	79
	Al. ***Puccinellion limosae***					
12	*Puccinellietum limosae*	14	Flat	0-15	55	90
13	*Cynodonto-Festucetum pseudovinae*	12	Flat,W,SW	0	62	77
	Al. ***Scorzonero-Juncion gerardii***					
14	*Astero tripoli-Juncetum gerardii*	10	Flat	0	20	88
15	*Agrostio stoloniferae-Caricetum distantis*	8	Flat	0	48	84
	Al. ***Beckmannion eruciformis***					
16	*Beckmannietum eruciformis*	8	Flat	0-35	48	95
TOTAL AVERAGE		**213**	All	**0-35**	**95**	**85**

The average participation of forage species in the grasslands grassy carpet was 56% with large differences between the associations, namely from 7% for the associations *Agropyro pectinate-Stipetum capillatae* and *Jurineo arachnoideae - Stipetum*

lessingianae to 90% for the most valuable association *Trifolio - Lolietum perennis* (Table 2).

Table 2

Forage species participation, green mass production and pastoral value of grassland associations

No.	Grassland Associations	Species structure (%)		Green Mass Production		Pastoral Value	
		Forager	Harmful	t/ha	%	ind.	%
	Al. ***Alopecurion pratensis***						
1	*Ranunculo repenti-Alopecuretum pratensis*	71	15	12.67	162	59.9	154
	Al. ***Cynosurion***						
2	*Trifolio-Lolietum perennis*	90	2	19.00	243	85.2	218
	Al. ***Potentillion anserinae***						
3	*Agrostietum stoloniferae*	82	7	13.17	168	63.2	162
4	*Poo sylvicolae-Alopecuretum pratensis*	85	5	13.50	173	73.0	187
5	*Rorippo austriacae-Agropyretum repentis*	86	7	17.00	217	58.8	150
	Al. ***Festucion valesiacae***						
6	*Taraxaco serotinae-Festucetum valesiacae*	65	18	4.60	59	37.7	97
7	*Taraxaco serotinae-Bothriochloetum ischaemi*	10	63	0.58	7	6.3	16
8	*Thymo pannonici-Chrysopogonetum grylli*	68	18	12.30	157	31.5	81
9	*Artemisio austriacae-Poëtum bulbosae*	36	43	1.19	15	23.5	60
10	*Agropyro pectinate-Stipetum capillatae*	7	75	0.44	6	4.3	11
	Al. ***Stipion lessingianae***						
11	*Jurineo arachnoideae-Stipetum lessingianae*	7	72	0.45	6	4.7	12
	Al. ***Puccinellion limosae***						
12	*Puccinellietum limosae*	17	73	0.61	8	11.2	29
13	*Cynodonto-Festucetum pseudovinae*	30	47	1.25	16	15.3	39
	Al. ***Scorzonero-Juncion gerardii***						
14	*Astero tripoli-Juncetum gerardii*	82	6	3.57	46	42.1	108
15	*Agrostio stoloniferae-Caricetum distantis*	80	4	5.41	69	39.1	100
	Al. ***Beckmannion eruciformis***						
16	*Beckmannietum eruciformis*	87	8	19.43	248	67.3	173
TOTAL AVERAGE		**56**	**29**	**7.82**	**100**	**39.0**	**100**

Green mass production is very close to the degree of participation of valuable species in the grasslands grassy carpet, as would be normal.

Thus, in the *Trifolio - Lolietum perennis* association, 19

t/ha of forage green mass was assessed, 243% higher than the average of the other associations, which was 7.82 t/ha, quite good for the natural conditions in the area.

A remarkable production of 19.43 t/ha of green mass was also evaluated in the *Beckmannietum eruciformis* association, but of a lower pastoral value.

Very low productions around 0.5 t/ha of green mass was assessed in the associations dominated by *Stipa* sp. and *Botriochloa ischaemum* on grassy slopes degraded by soil erosion.

Regarding the pastoral value, a very good index of over 85 was assessed for the same association of *Trifolio - Lolietum perennis* and the lowest of 4.3 - 4.7 was assessed as degraded for the associations *Agropyro pectinate - Stipetum capillatae* and *Jurineo arachnoideae - Stipetum lessingianae* .

On average, a pastoral value index of 39 was assessed on the 16 associations, assessed as weak to mediocre (MARUȘCA et al. 2014).

After the evaluation of the grassland's productivity at associations level, the evaluation was carried out to the upper level of phytosociological alliances closer to the grassland habitats of the European level (GAFTA, MOUNTFORD, 2008).

From the synthesis of the 8 alliances, an average production of 9.42 t/ha green mass and 44.6 pastoral value index resulted, being considered medium in terms of productivity (Table 3).

Table 3

Optimal loading for 160 days of grazing season and cow milk production at phytosociological alliances level

Alliance	Green Mass Production		Optimal loading (LU/ha)	Average Pastoral Value (ind.)	Milk production	
	t/ha	%			L/ha	%
Alopecurion pratensis	12.67	145	1.22	59.9	5870	134
Cynosurion	19.00	202	1.83	85.2	8350	191
Potentillion anserinae	14.56	155	1.40	65.0	6370	145
Festucion valesiacae	3.82	41	0.37	20.7	2030	46
Stipion lessingianae	0.45	5	0.04	4.7	460	11
Puccinellion limosae	0.93	10	0.09	13.3	1300	30
Scorzonero-Juncion gerardii	4.49	48	0.43	40.6	3980	91
Beckmannion eruciformis	19.43	206	1.87	67.3	6700	153
AVERAGE	**9.42**	**100**	**0.91**	**44.6**	**4370**	**100**

The lowest production of 0.45 t/ha green mass allowing a load of 0.04 LU/ha was evaluated in the alliance *Stipion lessingianae* and the best in *Cynosurion* and *Beckmanion* with 19 - 19.43 t/ha and a load of 1.83 - 1.87 LU/ha in 160 days optimal grazing season.

Cow milk production averages 4370 litres/ha with a load

of 0.91 LU/ha, with the lowest in the *Stipion alliance* (460 litres/ha) and the best in *Cynosurion* (8350 litres/ha) and *Beckmanion* (6700 litres/ha) 50 - 91% higher.

These results come to complement the economic and applied part of the geobotanical research in the area under study, data that can still be used to draw up the pastoral arrangements.

CONCLUSIONS

The Crasna Basin permanent grasslands have a medium productivity, with 9.41 t/ha green mass (GMP), 44.6 pastoral value (PV), which allow an average load of 0.91 LU/ha and the production of 4370 liters of milk of cows per hectare in an optimal grazing season of 160 days.

At the alliances (habitats) level, the worst results were assessed at *Stipion lessingianae* with 0.45 GMP, 4.7 PV and 460 liters of milk/ha, and the best at *Cynosurion* with 19 t/ha GMP, 85.2 PV and 8350 liters of milk/ha.

The obtained data can further be used to draw up pastoral arrangements and an appropriate management in the future.

REFERENCES

1. Anghel Gh., Răvăruț M., Turcu Gh., 1971, *Geobotanica*, Ed. ”Ceres”, București
2. Borza Al., Boșcaiu N., 1965, *Introducere în studiul covorului vegetal*, Ed. Academiei Române, București
3. Ciocârlan V, 2009, *Flora ilustrată a României. Pteridophyta et al. Spermatophyta, Ed.* Ceres, București
4. Coldea Gh.,1991, *Documents phytosociologiques*, Nouvelle Série, Volume XIII, Università degli Studi, Camerino
5. Coldea Gh., Oprea A., Sîrbu I., Sîrbu C., Șterfan N., 2012, Les associations végétales de Roumanie, Tome 2, Le associations anthropogènes, Presa universitară clujeană
6. Cristea V., Gafta D., Pedrotti F., 2004, *Fitosociologie*, Editura Presa Universitară Clujeană
7. Gafta D., Mountford J.O., - Coord., 2008 - *Manual de interpretare a habitatelor Natura 2000 din România,* Ed. Risoprint, Cluj Napoca
8. Marușca T., Mocanu V., Haș E. C., Tod Monica A., Andreoiu A. C., Dragoș Marcela M. M., Blaj V. A., Ene T., Silistru Doina, Ichim E., Zevedei P., Constantinescu C., Tod S., 2014, *Ghid de întocmire a amenajamentelor pastorale,* Editura Capolavoro, Brașov, 248 pagini, ISBN 978-973-98711-8-1.
9. Marușca T., Blaj V. A., Mocanu V., Andreoiu Andreea C., Zevedei P. M., 2018, *Long term influence of botanical composition of alpine pastures on cow milk production,* Proceedings of the 27th General Meeting of the European Grassland

Federation, EGF, Volume 23, Pp. 283-285, Cork, Ireland, 17-21 iunie, ISBN 978-1-84170-643-6

10. Maruşca T., 2019, *Contributions to the evaluation of pasture productivity using the floristic releve*, Romanian Journal of Grassland and Forage Crops BDI Nr. 19, Cluj – Napoca, pp. 33- 47, ISSN 2068-3065
11. Maruşca T., Blaj V. A., Mocanu V., Andreoiu Andreea C., 2020, *Contributions on the establishment of productivity indicators for cow milk produced in the Carpathian Mountains*, Annals of the Academy of Romanian Scientists Series Agriculture, Silviculture and Veterinary Medicine Sciences BDI Online ISSN 2344 – 2085 Volume 9, Number 1, pp.70-74
12. Maruşca T., Oprea A., Taulescu Elena, Dragoş Marcela M., 2021a, *Contributions to the grasslands productivity assessment in Tecuci Plain and Siret Lower Basin*, Romanian Journal of Grassland and Forage Crops , Cluj Napoca, nr.23 pp.61-68, ISSN 2068-3065
13. Maruşca T., Oprea A., Sîrbu C., Samuil C., 2021b *Evaluation of the productivity of grass phytocoenoses of the Stănişoarei Mountains (Eastern Carpathians)*, Romanian Journal of Grassland and Forage Crops , Cluj Napoca, nr.24 pp. 15-22, ISSN 2068-3065
14. Maruşca T., 2022, *Productivity evaluation of the main grassland Habitats Natura 2000, fromthe Rarău Massive (Eastern Carpathians)*, Academy of Romanian Scientists Series on Agriculture, Silviculture and Veterinary Medicine Sciences, Volume 11, Number 1, pp. 45-49
15. Maruşca T. 2022, *Praticultură şi pastoralism în cercetarea ştiinţifică*, Editura Universităţii Transilvania din Braşov, 311 pagini, ISBN 978-606-19-1565-1
16. Maruşca T., Tomescu C.V., Dragoş Marcela M.M., Porr Cristina I., Comşia Cristina C., Dumea R., 2022, *Contributions to the grasslands productivity assessment from the Suceava River hydrographic Basin*, Romanian Journal of Grassland and Forage Crops , Cluj Napoca, nr.26 pp. 51-58, ISSN 2068-3065
17. Maruşca T., Gurău M., Dragoş Marcela, Porr Cristina, Comşia Cristina, 2023, *Contributions to the assessment of the grasslands habitats productivity in the Casin - Onești Depression and the Oituz Basin*, Romanian Journal of Grasslands and Forage Crops, nr. 27, pp. 55-62, ISSN 2068 - 3065
18. Oprea A., Maruşca T., 2022, *Contribution to the assessment of mountain grasslands productivity from Râmnicu Sărat River Basin*, Academy of Romanian Scientists Series on Agriculture, Silviculture and Veterinary Medicine Sciences, Volume 11, Number 1, pp. 50-61
19. Păcurar F., Rotar I, 2014, *Metode de studiu şi interpretare a vegetaţiei pajiştilor*, Editura Risoprint, Cluj Napoca
20. Puşcaru- Soroceanu Evdochia, Puşcaru D., Buia Al., Burduja C., Csűrös St. Grîneanu A., Niedermaier K., Popescu C.P., Răvăruţ M., 1963, *Păşunile şi fâneţele din R.P.Română, Studiu geobotanic şi agroproductiv*, Editura Academiei R.P.R., Bucureşti
21. Viţalariu Gh., 1975, *Flora şi vegetaţia Bazinului Crasnei (Podişul Central Moldovenesc)*, Teză de Doctorat, Universitatea ”Babeș-Bolyai” Cluj Napoca, Facultatea de Biologie-Geografie