PHYTOCOENOLOGIC STUDY OF ACIDOPHILOUS SESSILE OAK FORESTS ON THE SOHODOL VALLEY (PĂDUREA CRAIULUI MOUNTAINS)

Păşcuţ Călin Gheorghe*, Burescu Petru*

*University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048, Oradea, Romania, e-mail: pascutcalin@yahoo.com

Abstract

The paper presents a phytocoenologic study of acidophilic sessile oak forests of Sohodol Valley in Pădurea Craiului Mountains. In the acidophilic sessile oak forests we identified the Genisto tinctoriae-Quercetum petraeae association Klika 1932.

In the synthetic table of association a number of 5 phytocoenologic relevées were analyzed. They were made on Sohodol Valley in 2016. The phytocoenoses of the association were studied in terms of floristic composition, life forms, floristic elements and ecological factors (moisture, temperature and chemical reaction of the soil).

Key words: association, phytocoenoses, acidophilic, sessile oak, floristic elements, life forms, ecological factors

INTRODUCTION

Study of acidophilic sessile oak forests with *Genista ovata* from Sohodol Valley was done during the year 2016. These stands of sessile oak with dyer's broom are included in terms of functional zoning of forests in Group I Forests with special protection functions, subgroup 2 Forest of soil protection.

The vegetation of sessile oak forests in Sohodol Valley Basin has not been the subject of a vegetation study so far. Sohodol Valley is an area of contact, stretching from Căbeşti and Sohodol villages (Bihor county), to the watershed of Iadului Valley, being characterized as an area of interference, where floral elements from the neighbouring biogeographical regions have pervaded.

From geological point of view, in the studied area, at higher altitudes there is a frequency of sandstone bedrocks, sandy bedrocks, sandstone, bedrock, tuff, shale, gypsum which are Neogene, more exactly Pliocene and Miocene.

The territory under study is in the west of our country, in the upper - middle basin of Crişul Negru river, in the land of the Apuseni Mountains, in the peripheral Mountains of Zărand-Meseş district with the Northern subdistrict (Pădurea Craiului Mountains).

The predominant soils are cambisoil class: eutricambosoil, districambosoil and terra rossa.

The appropriate forest climate on Sohodol Valley is that of high hills and forested medium mountains. This climate is characterized by a more moderate regime of air temperature oscillations. The average annual temperature remains positive throughout the region, averaging between 8-9°C. In terms of climate zoning the territory is located in ''F.D.3 - Hilly sessile oak floor, european beech and sessile oak-beech forests".

A classification of sessile oak acidophilous vegetation in our country is presented in the work developed by Chifu (2014) and Indreica (2012). The *Genisto tinctoriae-Quercetum petraeae* association Klika 1932, is cited in our country in Moldova (Chifu et al., 2006), in Crisana (Coldea, 1972; Pop et al., 1978; Karácsonyi, 2011; Păşcuţ, Burescu, 2009), in Transylnania (Schneider-Binder, 1973; Drăgulescu, 1995; Ursu, 2013), in Oltenia (Sanda, Popescu, 1981), in Maramures (Raţiu, Gergely, 1979).

MATERIAL AND METHOD

The nomenclature used in this study is that adopted for Romanian Flora by Ciocârlan (2009). The setting the ecological factors, life forms, floristic elements, were made after the synthesis work developed by Ellenberg et al. (1992), Sanda et al. (1983, 2003), Ciocârlan (2009), Cristea et al. (2004), Burescu, Toma (2005).

The technique of making relevées and the quantitative and qualitative evaluation were done according to indications given by Cristea et al. (2004). The identification of the association was made based on floristic criterion, using characteristic, enlightening, differential and recognition species.

The naming of the association was made in accordance with provisions established by the International Code of Phytosociological Nomenclature (Weber et al., 2000). Classification of the association in the corresponding cenotaxonomic units to alliance, order and class was made in accordance with the traditional ecologic-floristic systems developed by Borhidi (2003) and Sanda et al. (2008).

The surface taken of the relevées is 400 m ². The phytocoenologic table drawn up for the studied association contains information regarding the floristic composition of populations of plants that make up the phytocoenoses: the individual of the association, life form, floristic element, ecological factors (moisture, temperature and chemical reaction of the soil), number of relevées, altitude (m.s.m.), exposition, consistency of tree layer, GPS coordonates (Lat. N, Long. E), hights of the trees (m), diameter of the trees (cm), herbaceous layer coverage (%), slope (º) and area (m²).

It is important for this study to analyze life forms, floristic elements, ecological factors and their graphic interpretation as spectra.

RESULTS AND DISCUSSION

The acidophilic ssesile oak forests with *Genista ovata* (Fig. 1), from Sohodol Valley, populate slopes steeply inclined (32-40°), on sunny exposition (southern, south-eastern and western), they are quartered between 720-750 m altitude, on rocks. Soils that are growing in this association are acidic, shallow, with much skeleton, located on conglomerates, shales and sandstones.

Fig. 1. Aspects with ass. *Genisto tinctoriae-Quercetum petraeae* from Sohodol Valley - Pădurea Craiului Mountains (Photo: Păşcuţ G., 14.05.2016)

The trees layer cover 40-70%, being dominated by *Quercus petraea*, accompanied by *Quercus dalechampii*, *Acer platanoides*, *Fraxinus excelsior*, *Carpinus betulus*, *Ulmus glabra*, *Acer pseudoplatanus*, *Fagus sylvatica*, *Tilia tomentosa*, *Sorbus torminalis*. The trees have diameters ranging from 34-42 cm and heights of 14-24 m.

Shrubs and the undergrowth layer is underrepresented, *Cornus mas* and *Rosa spinosissima* are worth to be mentioned.

The herbaceous layer with a coverage of 40-60%, is rich in species and consists essentially of *Genista ovata*, along with frequently occurring *Luzula luzuloides*, *Festuca rupicola* ssp. *saxatilis*, *Poa nemoralis*, *Dianthus carthusianorum*, *Polygonatum odoratum*, *Campanula persicifolia*, *Galium schultesii*, *Dentaria bulbifera*, *Carex digitata*, *Digitalis lanata*, *Sedum acre*, *Dianthus carthusianorum*.

In the floristic structure of the association the characteristic species of *Genisto germanicae-Quercion* aliance, *Quercetalia roboris* order can be found: *Luzula luzuloides*, *Polypodium vulgare*, *Quercus dalechampii*, *Solidago virgaurea*, *Hieracium umbellatum*, *Hieracium sabaudum*, as well as the characteristic species of *Querco-Fagetea* class: *Polygonatum odoratum*, *Acer platanoides*, *Campanula persicifolia*, *Fraxinus excelsior*, *Galium schultesii*, *Carpinus betulus*, *Dentaria bulbifera*, *Hedera helix*, *Carex digitata*.

In these phytocoenoses transgressive species from the *Quercetea pubescenti-Petraeae* class enter: *Tilia tomentosa*, *Digitalis lanata*, *Chamaecytisus hirsutus* ssp. *leucotrichus*, *Cephalanthera damasonium*, *Melittis melissophyllum*, *Sorbus torminalis*, *Cornus mas*, *Cytisus nigricans*, *Vincetoxicum hirundinaria*, as well as the *Asplenietea trichomanis* class: *Poa nemoralis*, *Cardaminopsis arenosa*, *Sedum maximum*, *Sempervivum marmoreum*, *Asplenium septentrionale*, and the *Festuco-Brometea* class: *Festuca rupicola* ssp. *saxatilis*, *Dianthus carthusianorum*, *Sedum acre*, *Thymus comosus*, *Silene bupleuroides* (Table 1).

Table 1

Genisto tinctoriae-Quercetum petraeae association Klika 1932

L.f.	F.e.	U.	T.	R.	Number	1	2	3	4	5	K
					Altitude (m.s.m.)	740	750	720	725	750	
					Exposition	E	S	SE	S	E	
					Consistency of tree layer	0,7	0,4	0,7	0,7	0,4	
					GPS Lat.N	46.78704	46.78753	46.78427	46.78567	46.78699	
					coordonates Long.E	22.51393	22.51440	22.50962	22.51291	22.51387	
					Hights of the trees (m)	8	12	19	18	12	
					Diameter of the trees (cm)	36	40	42	38	34	
					Herbaceous layer coverage (%)	50	40	50	60	45	
					Slope (degree) (°)	40	35	32	36	38	
					Area (m²)	400	400	400	400	400	
0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
MPh	E	2.5	3	0	*Quercus petraea*	4	3	4	4	3	V
nPh	Alp	2.5	3	3	*Genista ovata*	2	1	1	1	1	V
					Genisto germanicae-Quercion, Quercetalia roboris						
H	E	2.5	2.5	2	*Luzula luzuloides*	+	+	2	3	1	V
G	Cp	3.5	3	4	*Polypodium vulgare*	+	+	·	·	+	III
MPh	M	2.5	3	0	*Quercus dalechampii*	+	·	1	1	·	III
H	Cp	2.5	3	3	*Solidago virgaurea*	·	+	+	·	·	II
H	Cp	2.5	3	2.5	*Hieracium umbellatum*	·	·	·	+	+	II
H	E	2.5	3.5	2.5	*Hieracium sabaudum*	·	·	+	+	·	II
					Querco-Fagetea						
G	Eua	2	3	4	*Polygonatum odoratum*	+	·	+	+	+	IV
MPh	Eua	3	3	3	*Acer platanoides*	+	+	·	+	+	IV
H	Eua	3	3	0	*Campanula persicifolia*	+	+	·	+	+	IV
MPh	E	3	3	4	*Fraxinus excelsior*	1	+	·	·	+	III
G	Ec	2.5	3	3	*Galium schultesii*	+	·	+	+	·	III
MPh	E	3	3	3	*Carpinus betulus*	+	+	+	·	·	III
G	Ec	3	3	4	*Dentaria bulbifera*	·	·	+	+	+	III

0	1	2	3	4	5	6	7	8	9	10	11
l-nPh	Atl-M	3	3	3	*Hedera helix*	+	+	·	·	+	III
H	E	3	3	3	*Carex digitata*	·	·	+	+	+	III
MPh	Eua	4	3	3	*Ulmus glabra*	+	+	·	·	·	II
G	E	3	3	0	*Corydalis solida*	·	·	+	·	+	II
G	Carp	4	2	3	*Festuca drymeja*	·	·	+	+	·	II
H	Ec	3	0	4	*Lamium galeobdolon*	·	·	+	+	·	II
H	End Carp	4	2	3	*Leucanthemum waldsteineii*	+	+	·	·	·	II
H	Eua	3	0	3	*Hieracium murorum*	·	·	·	+	+	II
H	E	2.5	3	4	*Melica uniflora*	·	·	+	+	·	II
H	Cosm	4	2.5	0	*Athyrium filix-femina*	·	·	+	+	·	II
H	Carp	3	0	0	*Hieracium transsylvanicum*	+	+	·	·	·	II
H	Eua	3	3	4	*Brachypodium sylvaticum*	·	·	+	+	·	II
MPh	Ec	3.5	3	3	*Acer pseudoplatanus*	+	·	·	·	+	II
MPh	E	3	3	0	*Fagus sylvatica*	·	·	+	+	·	II
H	Eua	3	3	3	*Lathyrus vernus*	·	·	+	+	·	II
					Quercetea pubescenti-Petraeae						
MPh	B	2.5	3.5	3	*Tilia tomentosa*	+	·	+	+	·	III
TH	B	1.5	4	4.5	*Digitalis lanata*		+	+	+	·	III
nPh	Ec	2	3.5	4	*Chamaecytisus hirsutus* ssp. *leucotrichus*	·	+	·	·	+	II
G	E	2.5	3	4	*Cephalanthera damasonium*	·	·	+	+	·	II
H	Ec	2.5	3	5	*Melittis melissophyllum*	·	·	+	+	·	II
MPh	E	2.5	3	4	*Sorbus torminalis*	+	·	·	+	·	II
mPh	P	2	3.5	4	*Cornus mas*	·	+	·	·	+	II
nPh	Ec	2.5	3	0	*Cytisus nigricans*	·	·	·	+	+	II
H	E	2	4	4	*Vincetoxicum hirundinaria*	·	+	·	·	+	II
					Asplenietea trichomanis						
H	Eua	3	3	0	*Poa nemoralis*	+	+	2	1	1	V
TH	Ec	2.5	3	4	*Cardaminopsis arenosa*	+	+	·	+	·	III
H	Eua	2	3	0	*Sedum maximum*	+	+	·	·	+	III
Ch	Carp	1.5	2.5	2.5	*Sempervivum marmoreum*	·	+	·	·	+	II
H	Cp	1	3	2	*Asplenium septentrionale*	·	+	·	·	+	II
					Festuco-Brometea						
H	Alp	2	4	4,5	*Festuca rupicola* ssp. *saxatilis*	2	2	·	+	2	IV
H	E	2	5	5	*Dianthus carthusianorum*	1	+	·	·	+	III
Ch	Eua	0	3	3	*Sedum acre*	+	+	·	·	+	III
Ch	End Carp	2	3.5	4.5	*Thymus comosus*	·	1	·	·	+	II
H	P	1.5	4.5	4	*Silene bupleuroides*	·	+	·	·	+	II
					Variae syntaxa						
H	Eua	3	0	0	*Veronica chamaedrys*	+	·	+	+	+	IV
TH	Eua	2.5	3	0	*Viola tricolor* ssp. *saxatilis*	+	+	·	+	+	IV
nPh	Eua	2	3	4	*Rosa spinosissima*	1	+	·	+	·	III
H	Eua	3	0	3	*Galium mollugo*	+	·	·	+	+	III
					Bryophyta						
-	-	-	-	-	*Ctenidium molluscum*	3	·	·	·	1	II

Species that occur in a single relevé: *Stachys recta* (2); *Sedum sexangulare* (4); *Potentilla arenaria* (4); *Potentilla recta* (2); *Ajuga reptans* (2); *Piptatherum holciforme* (1); *Sorbus aucuparia* (5); *Hypericum perforatum* (1); *Rosa canina* (5); *Euphorbia seguieriana* (4); *Cornus sanguinea* (2); *Veronica officinalis* (2).

Place and date of relevées: Sohodol valley ; 1 - 2 (14.05.2016); 3 - 5 (17.05.2016).

where: L.f. - life forms; Mph - Megaphanerophytes; mPh - Mezophanerophytes; nPh - Nanophanerophytes; l-nPh - Climbing plants; Ch - Camephytes; H - Hemicryptophytes; G - Geophytes; TH - Biannual terophytes F.e. - floristic elements; Eua-Eurasian; Cp - Circumpolar; E - European; Ec - Central European; Alp - Alpine; Atl-M - Atlantic-Mediterranean; M - Mediterranean; Carp - Carpathian; Cosm - Cosmopolitan; B - Balcan; P - Pontic; End Carp - Carpathian endemism; U - humidity; T - temperature; R - the chemical reaction of the soil; K - constancy.

Coenotaxonomically the association is classified in *Querco-Fagetea* class Br.-Bl. et Vlieger in Vlieger 1937 em. Borhidi 1996, *Quercetalia roboris* order R. Tüxen 1931, *Genisto germanicae-Quercion* alliance Neuhäusl et Neuhäuslová-Novotná 1967.

The spectrum of life forms for *Genisto tinctoriae-Quercetum petraeae* association (Fig. 2), outlines the dominance of hemicryptophytes species (H=45,3%), followed by the phanerophytes (Ph=28,3%) and geophytes (G=13,2%).

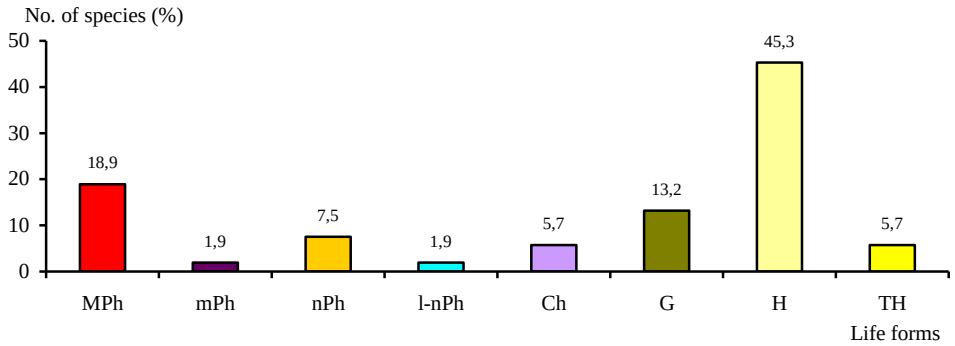

Fig. 2. The life forms spectrum of the *Genisto tinctoriae-Quercetum petraeae* Klika 1932 association

The spectrum of floristic elements (Fig. 3), certifies high weight of eurasian species (Eua=26,4%), closely followed by the european (E=24,5%) and central-european ones (Ec=15,1%), the remaining ones having a lower presence.

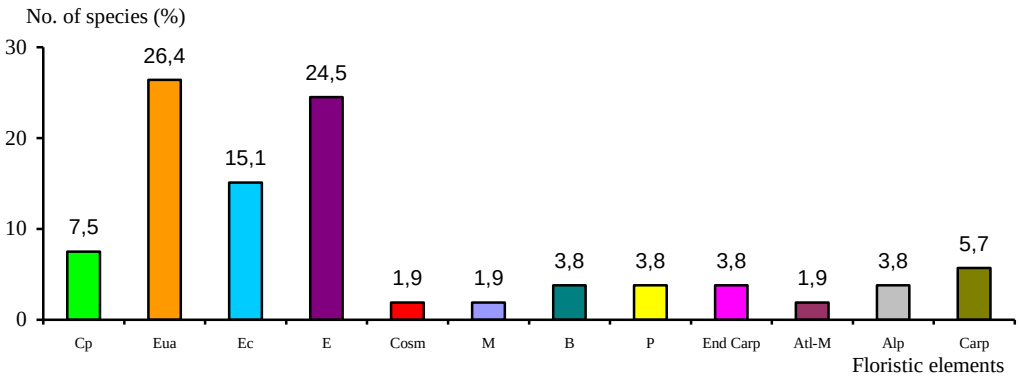

Fig. 3. Spectrum of floristic elements of the *Genisto tinctoriae-Quercetum petraeae* Klika 1932 association

The diagram of ecological factors (Fig. 4) suggests that, in terms of requirements for humidity, xero-mesophytes species dominate ($U_{2-2,5}$=47,1%), followed by the mesophyles ($U_{3-3,5}$=35,9%). Depending on the

temperature, we can notice the overwhelming dominance of micro-mesothermophylous species ($T_{3-3,5}$=71,7%), followed by the amphitolerant (T_0=9,5%) and microthermophylous ones ($T_{2-2,5}$=9,5%). The chemical reaction of the soil favours the weekly acido-neutrophylous species (U_4=34%), followed by the acido-neutrophylous (U_3=30,2%) and amphitolerant species (U_0=22,6%).

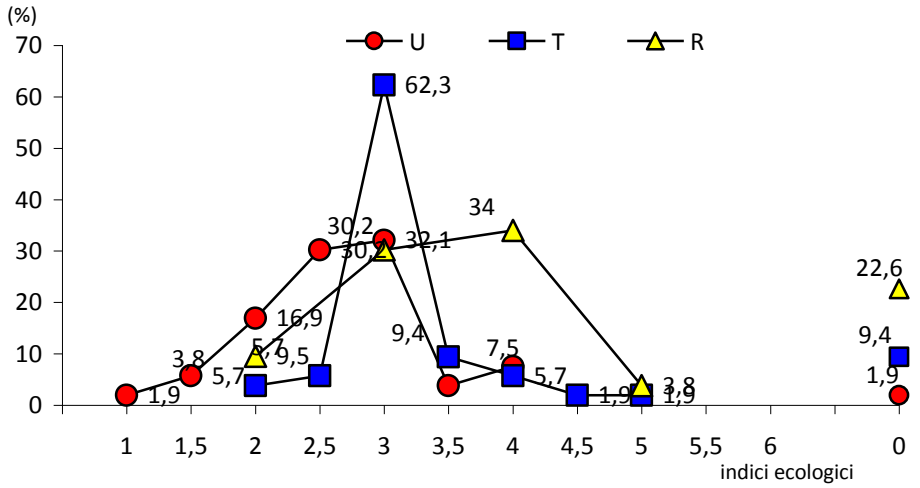

Fig. 4. Diagram of ecological factors for the *Genisto tinctoriae-Quercetum petraeae* Klika 1932 association

CONCLUSIONS

The acidophilic sessile oak forests from Sohodol Valley (Pădurea Craiului Mountains) grow on acidic rocks, on steep slopes and sunny expositions. The association studied by us is *Genisto tinctoriae-Quercetum petraeae* Klika 1932, that is specific to these acidophilous sessile oak forests in the area. The floristic composition of these phytocenoses includes 65 cormophyte species and a species of bryophytes (*Ctenidium molluscum*). These sessile oak forests house a number of rare, vulnerable, endemic species, such as: *Leucanthemum waldsteineii*, *Thymus comosus*, *Festuca rupicola* ssp. *saxatilis*, *Sempervivum marmoreum*, *Viola tricolor* ssp. *saxatilis*, *Cephalanthera damasonium*, *Digitalis lanata*.

In the floristic composition of these phytocenoses we can find, with high abundance, saxicole transgressive species from the *Asplenietea trichomanis* class and from the meadows specific to *Festuco-Brometea* class with low requirements of humidity (xerophytes and xero-mesophytes species). Sessile oak forests with *Genista ovata* from Sohodol Valley are included in functional Group I, Subgroup 2 protection of the soil against erosion, for this reason in these forests wood is not exploited.

REFERENCES

1. Borhidi A., 2003, Magyarország növénytársulásai. Akadémiai Kiadó, Budapest
2. Burescu P., Toma I., 2005, Manual de lucrări practice de botanică. Editura Universităţii din Oradea, pp.551-570
3. Chifu T., 2014, Diversitatea fitosociologică a vegetaţiei României III. Vegetaţia pădurilor şi tufărişurilor. Editura Institutul European, Iaşi, pp.551
4. Chifu T., Mânzu C., Zamfireascu O., 2006, Flora şi vegetaţia Moldovei (România). II Vegetaţia. Edit. Universităţii ,,Alexandru Ioan Cuza'', Iaşi, pp.698
5. Ciocârlan V., 2009, Flora ilustrată a României. Pteridophyta et Spermatophyta, Editura Ceres, Bucureşti, pp.1141
6. Coldea G., 1972, Flora şi vegetaţia Munţilor Plopiş. Rezum. Tezei de doct., Cluj-Napoca
7. Cristea V., Gafta D., Pedrotti F., 2004, Fitosociologie. Editura Presa Universitară Clujeană, Cluj-Napoca
8. Drăgulescu C., 1995, Flora şi vegetaţia din bazinului văii Sadului, Editura Constant, Sibiu, pp.355
9. Ellenberg H., Weber E.H., Düll R., Wirth V., Werner W., Paulissen D., 1992, Zeigerwerte von Pflanzen in Mitteleuropa. Scripta Geobotanica, 2 Aufl. E. Goltze Verlag, Göttingen
10. Indreica A., 2012, Vegetation classification of acidophytic oak forests of Romania. Phytocoenologia, 42(3-4), pp.221-230
11. Karácsonyi C., 2011, Flora şi vegetaţia Dealurilor Tăşadului şi a colinelor marginale. ,,Vasile Goldiş´´ University Press, Arad, pp.367
12. Păşcuţ C.G., Burescu P., 2009, Phytocenology research on pure sessile oak forests in Codru-Moma Mountains. ,,Natural Resources and Sustainable Development'', Analele Universităţii din Oradea, Vol.XIV, pp.604-610
13. Pop I., Ardelean M., Codreanu V., Crişan A., Cristea V., Csűrös-Káptalan M., Csűrös Ş., Ghişa E., Hodişan I., Raţiu O., Szász E., 1978, Flora şi vegetaţia Munţilor Zărand. Contrib. Bot., Cluj-Napoca, 18, pp.1-215
14. Raţiu O., Gergely I., 1979, Caracterizarea sinecologică a principalelor fitocenoze lemnoase din „Ţara Oaşului" (jud. Satu Mare). Contrib. Bot., Cluj-Napoca, pp.85-118
15. Sanda V., Popescu A., 1981, Contributions à la végétation du bassin moyen de Jiu. Revue Roum. de Biol., Série de Bot., Bucureşti, 26(2), pp.103-115
16. Sanda V., Popescu A., Doltu I., Doniţă N., 1983, Caracterizarea ecologică şi fitocenologică a speciilor din flora României. Stud. şi Com., Muz. Brukenthal, Sibiu, supliment, 25, pp.1-126
17. Sanda V., Biţă N.C., Barabaş N., 2003, Flora cormofitelor spontane şi cultivate din România. Editura Ion Borcea, Bacău
18. Sanda V., Öllerer K., Burescu P., 2008, Fitocenozele din România. Sintaxonomie, structură, dinamică şi evoluţie, Edit. Ars Docendi, Bucureşti, pp.570
19. Schneider-Binder E., 1973, Pădurile din depresiunea Sibiului şi a dealurilor marginale. I, Muz. Brukenthal., Studii şi Comunic. Şti. Nat., Sibiu, 18, pp.71-100
20. Ursu T.M., 2013, Vegetaţia din partea superioară a interfluviului Arieşul Mare-Arieşul Mic: (Munţii Bihorului). Rezumat teză de doctorat, Cluj-Napoca
21. Weber H.E., Moravec J., Theurillat J.P., 2000, International Code of Phytosocilogical Nomenclature. 3rd edition, Journal of Vegetation Science II, Opulus Press Uppsala, pp.739-768