THE BRYOPHYTE FLORA OF THE SZENT ISTVÁN UNIVERSITY GÖDÖLLŐ BOTANICAL GARDEN

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Abstract: This is the first bryofloristic study in the Gödöllő Botanical Garden of Szent István University. The aim of the study was to determine the species composition, taxonomic and ecological diversity of bryophytes of the garden and to determine their prevalence in the area. Altogether 69 bryophyte taxa (3 liverworts and 66 mosses) were identified belonging to 24 families and 44 genera. Most species were found in the research area in epigeic habitats (26 taxa) and least were found in epixylic habitats (5 taxa). Most of them are considered to be common in Hungary, however, five species are listed as near threatened on the current Hungarian Red Data List: Brachythecium glareosum, Dicranella howei, Didymodon insulanus, Fissidens viridulus, Nyholmiella obtusifolia.

Keywords: bryophyte diversity, life strategy, semi-natural habitats, comparison

INTRODUCTION

The first significant research into the bryoflora of Hungarian botanical gardens and arboretums was in 1954 of Vácrátót (Vajda 1954) and Szliglet (Vajda 1968). After the 2000s, the number of bryofloristical publications increased and to date 11 botanical gardens have been investigated in Hungary. In addition to the above, bryophyte surveys have been carried out in Zirc (Galambos 1992, Szűcs 2013), Agostyán (Szűcs 2009), Soroksár (Németh and Papp 2016), manor park of Martonvásár (Nagy et al. 2016), Eger (Szűcs and Pénzesné-Kónya 2016, Szűcs et al. 2017), Sopron (Igmándy 1949, Szűcs 2017), Buda (Rigó et al. 2019), Erdőtelek (Szűcs and Fintha 2019) and Göd (Fintha et al. 2020).

The locations of the vascular plants in arboretums are consciously chosen by gardener, but mosses spontaneously select...
the optimal habitats. They cover all accessible and favorable surfaces and are represented by many ecological groups, including epigeic, epixylic, epilithic, epiphytic and aquatic. The present research introduces the first bryofloristic study in the Szent István University Gödöllő Botanical Garden. The main objective of the study was to determine the species composition, taxonomic and ecological diversity of bryophytes of the garden and to determine their substrate prevalence in the area.

MATERIAL AND METHODS

Field studies were conducted between September and December 2020. The bryological material was collected in all habitats. Site details include data in the following order: habitats, GPS-coordinates and date of collection. Herbarium specimens were deposited in the Cryptogamic Herbarium of the Department of Botany and Plant Physiology at the Eszterházy Károly University, Eger (EGR). The evaluation of life strategies of bryophytes is according to Dierßen (2001). In order to characterise the conservation status of taxa, the Hungarian Red List was used (Papp et al. 2010). Nomenclature follows the classification of Király (2009) for the vascular plants. The nomenclature of mosses and liverworts follows Hodgetts et al. (2020). We used the Sørensen index (Sørensen 1948) for the comparison of the species composition of different localities.

Study area
The Gödöllő Botanical Garden of Szent István University was founded in 1959 after the University of Agricultural Sciences moved from Budapest to Gödöllő (S. Taba and Tuba 1999). In the next 3 years the first agrobotanical garden of Hungary was completed (Hortobágyi 1963). It is situated on the slopes of the Gödöllő Hills (GPS coordinates: 47.593027, 19.366136) at an altitude of 220 m above sea level (S. Taba and Tuba 1999). The Garden is located in the heart of the Gödöllő campus area of Szent István University, and occupies a 4.3 hectares site. It provides the teaching and research collection of living plants for the university, which counts over 1250 taxa. The botanical garden is a nature conservation area since 2008, and has over 110 protected higher plant species of the Hungarian Flora. After creating the necessary
infrastructure the garden has opened for visitors in 2011 (Szirmai et al. 2014).

Habitats and collections of the garden
Native and endangered open and closed sandy grassland communities have been created on a ca. 2500 m² area in 2009 (Czóbel et al. 2012), representing the once characteristic grassland vegetation of the Gödöllő Hills. More than a quarter of the garden is covered by a unique, natural forest stand, which belongs to a rare community “Aceri campestri-Quercetum roboris”. These relict forest patches have national importance.

Aquatic habitats consists of four ponds. The “central pond”, the oldest of the aquatic habitats, was constructed in the 1960’s and is located in the centre of the systematic beds. The “small pond” beside the entrance was completed in 2010. The “upper pond” was evolved in 2010 in order to enrich the landscape in the upper part of the garden. The fire water reservoir the largest of the aquatic habitats was established in 2015 and home of floating aquatic plants.

The tiny rock gardens display Hungarian native plants e.g. liverleaf (Hepatica nobilis) in addition those from mountainous parts of Europe and around the world (Szirmai et al. 2014).

Site details
The identifiers of the quadrates according to the Central European Flora Mapping System were indicated in square brackets (Király et al. 2003). Each collection point belongs to the 8482.1 square. The bryofloristic exploration was carried out by the authors in the whole area of the botanical garden, exploring the marked microhabitats. The data of the indicated collection sites (Figure 1), provide the serial number of the collection site, the name of the habitat, the date of collection and the GPS coordinates.
1. shady, sandy and gravelly soil, artificial stone, limestone, bark (07.09.2020., 04.12.2020.) N47°35'35.0” E19°21’58.6”
2. sandy soil, limestone (07.09.2020., 27.10.2020., 04.12.2020.) N47°35’34.8” E19°21’59.5”
3. shady limestone, gravelly soil (27.09.2020., 04.12.2020.) N47°35’34” E19°22’00”
4. sandy soil in the greenhouse (07.09.2020.) N47°35’35.0” E19°21’59.0”
5. lawn, shady soil, concrete (07.09.2020., 27.10.2020., 04.12.2020.) N47°35’36.8” E19°21’58.6”
6. lawn, shady soil (07.09.2020., 29.10.2020., 04.12.2020.) N47°35’34.8” E19°21’59.5”
7. wet soil (07.09.2020., 27.10.2020.) N47°35’37” E19°22’04”
8. shady artificial stone, lawn, concrete, bark (07.09.2020., 29.10.2020., 04.12.2020.) N47°35’36” E19°22’05.8”
9. dry sandy soil, artificial stone, concrete (07.09.2020., 04.12.2020.) N47°35’34” E19°22’06”
10. shady soil, artificial stone, decayed wood, bark (07.09.2020., 04.12.2020.) N47°35’34.8” E19°21’59.5”
11. shady soil, limestone, slate roof, decayed wood, bark (07.09.2020., 04.12.2020.) N47°35’32” E19°22’04”
12. shady soil, decayed wood, bark (07.09.2020., 29.10.2020., 04.12.2020.) N47°35’33” E19°22’02”
RESULTS AND DISCUSSION

List of species
Identified taxa are listed in alphabetical order with liverworts and mosses listed separately. The name of species and author is followed by the endangered status of the taxa, which categories are given on the basis of the current Hungarian Red List (Papp et al. 2010): LC – least concern; LC-att – least concern attention; NT – near threatened. This is followed by the locality of the species within the research area and the specification of the substrate.

Marchantiophyta

*Frullania dilatata* (L.) Dumort – LC – 1: bark of *Alnus glutinosa*
*Porella platyphylla* (L.) Pfeiff. – LC – 10: bark of *Acer platanoides*
*Radula complanata* (L.) Dumort – LC – 6: bark of *Acer platanoides*

Bryophyta

*Abietinella abietina* (He dw.) M. Fleisch. – LC – 6: disturbed soil
*Amblystegium serpens* (Hedw.) Schimp. – LC – 1: wet rock, 2: bark of *Acer platanoides*, 3: limestone, 4: sandy soil in greenhouse, 7: wet soil, 9: bark of *Quercus petraea*, 10: artificial stone; 11, 12: soil
*Atrichum undulatum* (Hedw.) P. Beauv. – LC – 9, 10: soil
*Barbula unguiculata* Hedw. – LC – 1: artificial stone; 3: gravelly soil
*Brachythecium albicans* (Hedw.) Schimp. – LC-att – 7: wet soil
*Brachythecium glareosum* (Bruch ex Spruce) Schimp. – NT – 4: sandy soil in greenhouse
*Brachythecium mildeanum* (Schimp.) Schimp. – LC-att – 7: wet soil
*Brachythecium rivulare* Schimp. – LC-att – 1, 9: shady soil, 7: wet soil
*Brachythecium rutabulum* (Hedw.) Schimp. – LC – 1, 2, 5, 6, 8, 10, 11, 12: soil; 7: wet soil
*Brachythecium salebrosum* (Hoffm. ex F. Weber& D. Mohr) Schimp. – LC – 7: wet soil; 9: bark of *Quercus petraea*
*Bryoerythrophyllum recurvirostrum* (Hedw.) P.C. Chen – LC-att – 2: limestone
**Bryum argenteum** Hedw. – LC – 1, 8, 9, 11: artificial stone; 3: gravelly soil

**Bryum dichotomum** Hedw. – LC – 5: soil

**Calliergonella cuspidata** (Mitt.) Loeske – LC – 1: soil; 7: wet soil

**Ceratodon purpureus** (Hedw.) Brid. – LC – 1, 5, 10: soil and artificial stone

**Climacium dendroides** (Hedw.) F. Weber & D. Mohr – LC-att – 6: disturbed soil

**Dicranella howei** Renauld & Cardot – NT – 10: soil

**Dicranella varia** (Hedw.) Schimp. – LC – 1, 5, 8: soil

**Dicranum montanum** Hedw. – LC – 10: decayed *Quercus petraea*

**Dicranum tauricum** Sapjegin – LC – 10: decayed *Quercus petraea*

**Didymodon acutus** (Brid.) K. Saito – LC-att – 2: limestone

**Didymodon insulanus** (De Not.) M.O. Hill – NT – 1: limestone

**Didymodon rigidulus** Hedw. – LC-att – 1, 2, 3: limestone

**Didymodon tophaceus** (Brid.) Lisa – LC-att – 1: soil; 3: gravelly soil

**Drepanocladus aduncus** (Hedw.) Warnst. – LC – 7: wet soil

**Fissidens taxifolius** Hedw. – LC – 1, 3: soil

**Fissidens viridulus** (Sw.) Wahl. – NT – 8: soil

**Grimmia pulvinata** (Hedw.) Sm. – LC – 1, 3: limestone; 5, 10: artificial stone

**Homalothecium lutescens** (Hedw.) H. Rob. – LC – 8: soil

**Homalothecium sericeum** (Hedw.) Schimp. – LC – 2, 3: limestone; 8: artificial stone

**Homomallium incurvatum** (Schrad. ex Brid.) Loeske – LC – 2, 3: limestone; 10: artificial stone

**Hygroamblystegium varium** (Hedw.) Mönk. – LC-att – 7: wet soil

**Hypnum cupressiforme** Hedw. – LC – 1: bark of *Magnolia x soulangeana*; 2, 3: limestone; 7: wet soil; 8, 11: soil; 10: artificial

**Leptodictyum riparium** (Hedw.) Warnst. – LC – 1: soil, limestone

**Leskea polycarpa** Hedw. – LC – 1: bark of *Magnolia x soulangeana*; 6: bark of *Sophora japonica*

**Lewinskya affinis** (Schrad. ex Brid.) F. Lara, Garielleti & Goffinet – LC – 1: bark of *Magnolia x soulangeana*; 9: bark of *Quercus petraea*

**Lewinskya speciosa** (Nees) F. Lara, Garielleti & Goffinet – LC-att – 12: bark of *Quercus petraea*

**Nyholmiella obtusifolia** (Brid.) Holmen & E. Warncke – NT – 1: bark of *Magnolia x soulangeana*; 6: bark of *Acer platanoides*
Orthotrichum anomalum Hedw. – LC – 2: limestone; 6: bark of Acer platanoides
Orthotrichum cupulatum Brid. – LC-att – 2: limestone
Orthotrichum diaphanum Brid. – LC – 1: limestone; 10: artifical stone
Oxyrrhynchium hians (Hedw.) Loeske – LC – 1, 2, 11, 12: soil; 7: wet soil
Plagiomnium cuspidatum (Hedw.) T.J. Kop. – LC – 1, 9: soil; 3: limestone; 9: bark of Quercus petraea
Plagiomnium rostratum (Schrad.) T.J. Kop. – LC – 3: soil
Plagiomnium undulatum (Hedw.) T.J. Kop. – LC – 1, 9, 10, 12: soil; 7: wet soil
Platygyrium repens (Brid.) Schimp. – LC – 1: bark of Magnolia x soulangiana; 9: bark of Quercus petraea
Pseudanomodon attenuatus (Limpr.) Ignatov & Fedosov – LC – 12: decayed Quercus petraea
Pseudocrossidium hornschuchianum (Schultz) R.H. Zander – LC – 3: soil
Pseudoleskeella nervosa (Brid.) Nyholm – LC – 1: bark of Alnus glutinosa
Ptychostomum capillare (Hedw.) Holyoak & N. Pedersen – LC – 1: bark of Alnus glutinosa
Ptychostomum imbricatulum (Müll.Hal.) Holyoak & N. Pedersen – LC – 1: soil
Ptychostomum moravicum (Podp.) Ros & Mazimpaka – LC – 2: bark of Acer platanoides
Pulvigera lyellii (Hook. & Taylor) Plášek, Sawicki & Ochyra – LC – 1: bark of Magnolia x soulangiana; 2: bark of Paulownia tomentosa; 6: bark of Sophora japonica
Pylaisia polyantha (Hedw.) Schimp. – LC – 2: bark of Paulownia tomentosa; 6: bark of Sophora japonica
Rhytidiadelphus squarrosus (Hedw.) Warnst. – LC – 1, 5: soil
Schistidium crassipilum H. H. Blom – LC – 2: limestone; 10: artifical stone
Schistidium elegantulum H. H. Blom – LC-att – 2, 11: limestone
Sciuro-hypnum populeum (Hedw.) Ignatov & Huttunen – LC – 1: soil; 11: limestone
Syntrichia papillosa (Wilson) Jur. – LC-att – 1: bark of Magnolia x soulangiana
**Syntrichia ruralis** (Hedw.) F. Weber & D. Mohr – LC – 1: bark of *Magnolia x soulangena*; 2: bark of *Paulownia tomentosa*; 5, 10: artifical stone

**Syntrichia virescens** (De Not.) Ochyra – LC-att – 2: bark of *Paulownia tomentosa*; 6: bark of *Sophora japonica*

**Thuidium assimile** (Mitt.) A.Jaeger – LC – 8, 9: soil

**Tortella squarrosa** (Brid.) Limpr. – LC – 6, 8: lawn

**Tortula acaulon** (With.) R.H.Zander – LC – 6, 8: disturbed soil

**Tortula caucasica** Broth. – LC-att – 8: soil

**Tortula muralis** Hedw. – LC – 1, 2, 3: limestone; 5, 10: artifical stone

**Bryophyte diversity**

During the research, 69 species of bryophytes (3 species of liverworts and 66 mosses) were found. These species belong to 24 families and 44 genera (*Figure 2*). Among the reported families the most numerous in terms of the species number were *Pottiaceae* (14 taxa) and *Brachytheciaceae* (10 taxa).

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**Figure 2.** Distribution of bryophyte species found in the Gödöllő Botanical Garden among families (Taxonomy follows Hodgetts *et al.* 2020).

Many of the common mosses of the Gödöllő Botanical Garden can be found in the most Hungarian botanical gardens, for example: *Amblystegium serpens*, *Barbula unguiculata*, *Brachythecium rutabulum*, *B. salebrosum*, *Bryum argenteum*, *Calliergonella cuspidata*, *Ceratodon purpureus*, *Fissidens taxifolius*, *Grimmia pulvinata*, *Homalothecium lutescens*, *H. sericeum*, *Hypnum*...
cuppessiforme, Leskea polycarpa, Lewinskya affinis, Orthotrichum diaphanum, Oxyrrhynchium hians, Plagiomnium cuspidatum, Syntrichia ruralis, Tortula muralis.

There are 5 taxa in Gödöllő Botanical Garden, which are not known from other botanical gardens in Hungary: Brachythecium mildeanum, Dicranum montanum, D. tauricum, Didymodon tophaceus, Fissidens viridulus.

Compared to the studied areas, this research area shows the least common species with the Arboretum of Agostyán (20 taxa), while the most with the Aboretum of Vácrátót (54 taxa) bryophyte flora. The Arboretum of Erdőtelek shows the greatest similarity in species composition with this research area (highest Sørensen index of 0.6).

![Figure 3. Comparison of arboretums, botanical gardens and manor parks by species number in Hungary. Comparative data were obtained from the following sources: Martonvásár (Nagy et al. 2016), Soroksár (Németh and Papp 2016), Agostyán (Tata) (Szűcs 2009), Vácrátót (Vajda 1954, Palotai 2018), Zirc (Galambos 1992, Szűcs 2013), Sopron (Szűcs 2017), Szilvásvárad (Vajda 1968), Budapest (Rigó et al. 2019), Eger (Szűcs et al. 2017), Erdőtelek (Szűcs and Fintha 2019), Göd (Fintha et al. 2020).](image-url)

It is a typical trend that the larger the garden, the greater the number of species. The deviation from this is remarkable in Soroksár and Martonvásár characterized by large area and low number of species as well as in Tata (Agostyán). However the latter
is also due to the fact that the entire bryophyte flora the Agostyán Arboretum has not yet been studied. The Gödöllő Botanical Garden, with its 4.3 hectares and 69 bryophytes, also differs from the trend, because the number of bryoflora species is outstandingly high compared to other gardens of similar size (Figure 3).

**Life strategies**
There is a remarkable difference between Gödöllő Botanical Garden and the Arboretum of Erdőtelek concerning the percentage of species in each of the life strategy categories (Dierßen 2001). Gödöllő Botanical Garden is more abundant in colonists and perennials, and less abundant in annual shuttle and long-lived shuttle species. None of the bryophytes in Gödöllő Botanical Garden belong to the fugitive categorie (Figure 4).

A possible explanation for this rate is the existence of constant and optimal conditions in the garden and plenty of natural rock surfaces, tree bark and open grassland are available for bryophytes, but disturbed substrates are rare in the study area.

![Figure 4. Comparison of the life strategies of bryophytes in Arboretum of Erdőtelek (Szűcs and Fintha 2019) and Gödöllő Botanical Garden (present study).](image)

**Types of habitats**
During the research we distinguished five types of habitats covered by bryophytes: epigeic, epilithic, epiphytic, epixylic and aquatic.
Most species were found on epigeic (44%) and epilithic habitats. Due to four artificially created wetlands, 25% of the species identified in the area were also found in aquatic habitats: *Amblystegium serpens, Brachythecium albicans, B. mildeanum, B. rivulare, B. rutabulum, B. salebrosum, Calliergonella cuspidata, Drepanocladius aduncus, Hygroamblystegium varium, Hypnum cupressiforme, Leptodictyum riparium, Oxyrrhynchium hians, Plagiommium cuspidatum, P. undulatum.*

Due to the fact that many tree species occur in the garden most diverse habitat types among the reported ones was the epiphytic one, this type includes: *Acer platanoides, Quercus petraea, Magnolia sp., Paulownia tomentosa, Sophora japonica, Alnus glutinosa.* Bryophytes that prefer these substrates can be classified into the following families: *Frullaniaceae, Leskeaceae, Orthotrichaceae, Pottiaceae, Radulaceae.*

Despite the occurrence of many stumps and decaying wood lying in the relict forest stand, the smallest number of species was found here: *Dicranum montanum, D. tauricum, Lewinskya affinis, Orthotrichum anomalum, Plagiommium cuspidatum.*

Most species are found on multiple substrates within the same habitat, but some taxa occur in only one place in the garden. Species registered from only one place are: *Atrichum undulatum* in the education trail, *Drepanocladius aduncus* in the upper pond and *Plagiommium rostratum* on soil near the entrance, *Pseudanomodon attenuatus, Dicranum montanum* and *D. tauricum* in decayed *Quercus petraea.*

The species that occupy the largest space in the garden are non-specialist terricolous taxa: *Abietinella abietina, Atrichum undulatum, Calliergonella cuspidata, Plagiommium cuspidatum, P. undulatum, Rhytidiadelphus squarrosus* and *Thuidium assimile.*

**CONCLUSIONS**

Despite of the small size this garden has a remarkable bryophyte diversity. The rich bryophyte flora can be partly explained by the presence of different habitats, the abundance of old and diverse deciduous trees and the presence of artificially created wetlands. Consequently, in semi-urban ecosystems, this botanical garden like green areas, is an important refuge for bryological diversity.
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REFERENCES

CZÓBEL, Sz., PAP, K., HUSSZTI, E., SZIRMAI, O., PÁNDI, I., NÉMETH, Z., VIKÁR, D. & PENKSZA, K. (2012). Nyílt homokpusztagyep társulás magszórásos technikával történt kilakításának előzetes eredményei ex situ körülmények között (Preliminary results of ex situ restoration of open sandy grassland community based on seed-mix sowing). Természetvédelmi Közlemények 18: 127–138.

DIERSEN, K. (2001). Distribution, ecological amplitude and phytosociological characterization of European bryophytes. Bryophytum Bibliotheca 56: 1–289.

FINTHA, G., SZÜCS, P. & ERZBERGER, P. (2020). A gödi Huzella Kert mohaflórája (The bryophyte flora of Huzella Garden in Göd (Pest county, Hungary)). Botanikai Közlemények 107(1): 87–101. https://doi.org/10.17716/BotKozlem.2020.107.1.87

GALAMBOS, I. (1992). A Zirci Arborétum mohaflórája (The bryophyte flora of the Arboretum Zirc). Folia Musei historico-naturalis Bakonyiensis 11: 29–35.

HODGETTS, N.G., SÖDERSTRÖM, L., BLOCKEEL, T.L., CASPARI, S., IGNATOV, M.S., A. KONSTANTINova, N.A., LOCKHART, N., PAPP, B., SCHRÖCK, C., SIM-SIM M., BELL D., BELL N.E., BLom, H. H., BRUggeman-NANNenga, M.A., M. BRUGóJES, M., ENROTH, J., FLATBERG, K.I., GARILLETI, R., HEDENÁS, L., HOLYOAK, D.T., HUGonnOT, V., KARiWAYASAM, I., KÖCKiNGER, H., KUCÉRA, J., LARA, F. & PORLEY, R.D. (2020). An annotated checklist of bryophytes of Europe, Macaronesia and Cyprus. Journal of Bryology 42(1): 1–116. https://doi.org/10.1080/03736687.2019.1694329

HORTOBÁGYI, T. (1963). The agrobotanical garden of Gödöllő. Természetudományi közlőny 7(4): 151–153.

IGMÁNDY, J. (1949). Adatok Sopron mohaflórájához. Erdészeti kisérletek 49: 164–167.

KIRÁLY, G., BALOGH, L., BARINA, Z., BARTHA, D., BAUER, N., BODONCSI, L., DANCZA, I., FARKAS, S., GALAMBOS, I., GULYÁS, G., MOLNÁR, V.A., NAGY, J., PIFFÓ, D., SCHMOTZER, A., SOMLYAI, L., SZMrAD, F., Videdíki, R., VoJtőkó, A. & ZóLyomi, Sz. (2003). A Magyarországi Fióratérképezés módszertani alapjai. Flora Pannonica 1: 3–20.

KIRÁLY, G. (ed.) (2009). Új magyar füvészkönyv (Magyarország hajtásos növényei, határozókulcsok). Aggteleki Nemzeti Park Igazgatóság, Jósvafő, 616 pp.

NAGY, Z., MAJLÁTH, I., MOLNÁR, M. & ERZBERGER, P. (2016). A Martonvásári Kastélipark mohaflórája (Bryofloristical study in the Brunszvik manor park in Martonvásár, Hungary). KitaiHelio 21(2): 198–206. https://doi.org/10.17542/kita.21.198

NÉMETH, Cs. & PAP, B. (2016). Mohák a Soroksári Botanikus Kertben. In: HöHN, M. & PAP, V. (eds.): Biodiverzítást a Soroksári Botanikus Kertben. Magyar Biodiverzítás-kutató Társaság and SZIE Kertészettudományi Kar, Soroksári Botanikus Kert, Budapest, pp. 111–149.
PALOTAI, B. (2018). A Vácrátói Nemzeti Botanikus Kert mohának ismételt feltérképezése. Szakdolgozat, Szent István Egyetem Kertészettudományi Kar, Budapest, 48 p.

PAPP, B., ERZBERGER, P., ÓDOR, P., HOCK, ZS., SZÖVÉNYI, P., SZURDOKI, E. & TÓTH, Z. (2010). Updated checklist and Red List of Hungarian Bryophytes. Studia botanica hungarica 41: 31–59.

RIGÓ, A., KOVÁCS, A. & NÉMETH, Cs. (2019). A Budai Arborétum mohaflórája. (Bryophyte flora of the Buda Arboretum (Budapest, Hungary)). Botanikai Közlemények 106(2): 217–235.

https://doi.org/10.17716/BotKozlem.2019.106.2.217

S. TABA, E. & TÚBA, Z. (1999). A Szent István Egyetem (volt Gödöllői Agrártudományi Egyetem) Mezőgazdaság- és Környezettudományi Kara Növénytani és Növényélettani Tanszékének botanikus kertje. Botanikai közlemények 86–87(1–2): 221–228.

S. TÁBA, E. & TUBA, Z. (1999). A Szent István Egyetem (volt Gödöllői Agrártudományi Egyetem) Mezőgazdaság- és Környezettudományi Kara Növénytani és Növényélettani Tanszékének botanikus kertje. Botanikai közlemények 86–87(1–2): 221–228.

SØRENSEN, T. (1948): A method of establishing groups of equal amplitude in plant sociology based on similarity of species content. Kongelige Danske Videnskabe rnes Selskab. Biologiske Skrifter 4: 1–34.

SZIRMAI, O., HOREL, J., NEMÉNYI, A., PÁNDI, I., GYURICZA, Cs. & CZÖBEL, Sz. (2014). Overview of the collections of the first agrobotanical garden of Hungary. Hungarian Agricultural Research 23(3): 19–25.

SZŰCS, P. (2009). Mohaadatok az Agostyáni Arborétumból. (Data to the bryophyte flora of Agostyán Arboretum (Tata, NW Hungary). Komárom-Esztergom Megyei Múzeumok Közleményei 15: 159–164.

SZŰCS, P. (2013). Kiegészítések a Zirci Arborétum mohaflórájához (Contribution to the bryophyte flora of Arboretum Zirc (NW-Hungary)). Folia Musei Historico-Naturalis Bakonyiensis 30: 47–54.

SZŰCS, P. & PÉNZESNÉ-KÖNYA, E. (2016). Mohaadatok az Eszterházy Károly Főiskola Botanikus Kertjéből (Eger) (Bryophyte data from Botanic Garden of Eszterházy Károly College (Eger, NE-Hungary). Acta Academiae Paedagogicae Agriensis Nova Series: Sectio Biologiae 43: 53–57.

SZŰCS, P. (2017). Bryophyte flora of the Botanic Garden of the University of Sopron (W Hungary). Studia botanica hungarica 48: 77–88.

https://doi.org/10.17110/StudBot.2017.48.1.77

SZŰCS, P., TÁBORSKÁ, J., BARANYI, G. & PÉNZESNÉ-KÖNYA, E. (2017). Short-term changes in the bryophyte flora in the botanical garden of Eszterházy Károly University (Eger, NE Hungary). Acta Biologica Plantarum Argiensis 5(2): 52–60.

https://doi.org/10.21406/abpa.2017.5.2.52

SZŰCS, P. & FINTHA, G. (2019). The bryophyte flora of the Erdőtelek Arboretum in Hungary. Acta Biologica Plantarum Argiensis 7: 116–126.

https://doi.org/10.21406/abpa.2019.7.116

VAJDA, L. (1954). A Vácrátói Botanikai Kutató Intézet Természettudományi Parkjának mohái. (Die Moose im Naturschutzparke des Botanischen Forschungsinstitutes von Vácrátót.) Botanikai Közlemények 45: 63–66.

VAJDA, L. (1968). A Szigligeti Arborétum mohaí. A Veszprém Megyei Múzeumok Közleményei 7: 237–239.

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