

DISTRIBUTION OF *MEDICAGO ORBICULARIS* (FABACEAE) IN HUNGARY

Norbert BAUER

*Department of Botany, Hungarian Natural History Museum,
H–1087 Budapest, Könyves Kálmán krt. 40, Hungary; bauer.norbert@nhmus.hu*

Bauer, N. (2018): Distribution of *Medicago orbicularis* (Fabaceae) in Hungary. – *Studia bot. hung.* 49(2): 49–60.

Abstract: In recent years, *Medicago orbicularis* has been found at three new localities of Balaton Uplands. This paper, besides describes the habitat conditions of the new occurrences, summarises the information available concerning the distribution of the species in Hungary. Based on the historical overview of the earlier observations of the taxon (Buda Mts, Pannonhalma Hills, Villány Mts), as well as on the dynamics of the emergence and disappearance of the species, it can be assumed that the plant can be recorded as a species regularly present in the Hungarian flora, while at some spots it takes roots only temporarily. The warming and drying climate in the Carpathian Basin is likely to encourage the spreading of the xerothermic, weed species, while the increased tourism can also play its part in the emergence of the taxon at new territories.

Key words: Balaton Uplands, Mediterranean species, neophyte, temporary colonisation, weed

INTRODUCTION

Medicago orbicularis (L.) Bartal. is a species distributed in the Mediterranean and South Eurasian areas (URBAN 1873, RIKLI 1946, MEUSEL *et al.* 1965, DZYUBENKO & DZYUBENKO 2008). Recent plant identification handbooks of Hungary only indicate the recurrent occurrence of the taxon in the Villány Mountains (SIMON 1992, KIRÁLY 2009), but earlier it was also present in the Buda Mts and in the area of Pannonhalma Hills (see SADLER 1840, BORBÁS 1879, JÁVORKA 1925, SOÓ 1966). The species is a thermofrequent therophyte, within its natural area it grows in open dry grasslands, scrub patches, pastures, arable lands, weedy habitats and at road sides (SCHLOSSER & FARKAŠ-VUKOTINOVIC 1869, POSPICHAL 1899, FIORI 1925, DUKE 1981, etc.). In the non-Mediterranean areas of Europe (e.g. Belgium, the Netherlands), as well as in North America and Australia, adventive occurrences are known (SOÓ 1966, VERLOOVE 2006, NESOM 2009, AL-ATAWNEH *et al.* 2009, MAXTED 2011). According to KIKODZE *et al.* (2010), the species is also an adventive, established weed in Georgia. In Texas, nowadays, it is already widespread, it is highly invasive in disturbed habitats, while in natural habitats it is considered rare (NESOM 2009).

Over the past few years the species has been found at some points on the Eastern part of the Balaton Uplands. In addition to presenting the new data, this paper provides a synthesis of the data of the plant's prevalence in Hungary, and presents and discusses the habitat conditions of the new populations.

MATERIAL AND METHODS

The new occurrences of the species were discovered during systematic flora-mapping research of the Bakony Region. The following herbaria were examined related to the literature data collection: Hungarian Natural History Museum (BP), Eötvös Loránd University (BPU), University of Debrecen (DE), University of Pécs (JPU), Savaria Museum, Szombathely (SAV). The nomenclature of plant taxa follows KIRÁLY (2009), the syntaxa names follow BORHIDI *et al.* (2012). Phytosociological relevés in the stands were taken in order to document the habitat. The vegetation was sampled with the Braun-Blanquet quadrat method, using 2×2 m quadrats, but abundance of species given in percentage values. Altogether 5 phytosociological relevés representing the habitats are given in this article (Table 1).

RESULTS AND DISCUSSION

I collected *Medicago orbicularis* on the Sátor Hill at Balatonalmádi, on May 31, 2016, and on the same day the species was found nearby, at Szentkirályszabadja in the Alsó-telek-dűlő (both occurrences are located in the same CEU-quadrat: 8973.2). In both cases, the plants appeared at extremely warm places: on the Sátor Hill along a tourist trail on a heavily eroded rocky grassland slope, while at Alsó-telek locality it was collected near the gravel road and bicycle lane. The size of both populations was some dozens of stems. A newer, massive stand of hundreds of specimens of the species was found on June 6, 2018, on the western slope of Szent Kereszt Hill, at Felsőörs, facing to the Malom valley (8973.4). A few ten meters south of this site, in a similar grassland patch, a stock of less than a few-dozen specimens was found by Szabolcs Varga.

Overview of the Hungarian data of *Medicago orbicularis*

Herbarium specimens in the studied Hungarian herbaria (locality, collection date, collector, herbarium acronym, sheet Nr.): **Buda Mts** – s.d., “Adlersberg”, Sadler, J. (BP 96795); “Bergabhänge bei Ofen, 180 m”, 03.05.1873. Freyn, J. (BP 96783, 96789); “Steinige Abhänge des Blocksberges bei Ofen, Dolomit, 200 m”, 03.05.1873. Freyn, J. (BP 689966, 581907); 05.1876. “Blocksberg Dolomit”, Richter, L. (BP 9679);

Table. 1. Phytosociological relevés taken in habitats of *Medicago orbicularis* belonging to Balaton Uplands (1. Balatonalmádi: Sátor Hill, slope: 30°, exposition: S; 31.05.2016., N., Bauer, 2–4. Felsőörs: Szent Kereszt Hill, Malom-valley, slope: 25–40°, exposition: SW, 06.06.2018., N., Bauer; 5. Felsőörs: Szent Kereszt Hill, Malom-valley, slope: 45°, exposition: SW, 14.06.2018., Bauer N. & Varga Sz.)

Taxon	1	2	3	4	5
Arrhenatheretea					
<i>Arrhenatherum elatius</i>	–	–	–	–	3
<i>Dactylis glomerata</i>	–	–	–	–	+
<i>Securigera varia</i>	+	–	3	–	+
Bromo-Festucion pallentis					
<i>Convolvulus cantabrica</i>	3	3	1	1	3
<i>Medicago orbicularis</i>	1	3	1	+	+
<i>Stipa eriocalis</i>	30	–	–	–	–
Festucetalia valesiacae & Festucion rupicolae					
<i>Adonis vernalis</i>	–	–	–	–	1
<i>Anthemis tinctoria</i>	–	–	–	1	1
<i>Arenaria serpyllifolia</i>	+	–	–	–	–
<i>Campanula sibirica</i>	+	–	–	–	–
<i>Carex humilis</i>	8	–	–	–	–
<i>Crupina vulgaris</i>	+	–	–	–	–
<i>Elymus hispidus</i>	–	50	40	40	30
<i>Erysimum odoratum</i>	–	–	–	+	–
<i>Festuca rupicola</i>	–	–	1	10	10
<i>Fragaria viridis</i>	–	–	–	–	+
<i>Inula ensifolia</i>	+	–	–	–	–
<i>Inula oculus-christi</i>	–	+	–	5	3
<i>Lactuca viminea</i>	–	–	–	+	+
<i>Medicago rigidula</i>	–	1	+	+	–
<i>Melica transsilvanica</i>	–	3	–	–	1
<i>Muscari tenuiflorum</i>	+	–	–	–	–
<i>Orlaya grandiflora</i>	8	5	10	8	3
<i>Salvia nemorosa</i>	–	1	5	–	1
<i>Scorzonera austriaca</i>	+	–	–	–	–
<i>Verbascum phoeniceum</i>	–	1	3	1	+
<i>Vinca herbacea</i>	–	–	–	+	+
Festucetalia valesiacae & vaginatae, Festucion vaginatae & valesiacae					
<i>Allium flavum</i>	+	–	–	–	–
<i>Allium sphaerocephalon</i>	+	–	–	–	–
<i>Centaurea stoebe</i>	–	–	–	–	3
<i>Fumana procumbens</i>	5	–	–	–	–
<i>Helianthemum nummularium</i>	1	–	–	–	–
<i>Stachys recta</i>	1	–	–	–	1
Festuco-Brometea					
<i>Achillea pannonica</i>	–	–	1	–	–
<i>Acinos arvensis</i>	+	–	–	–	+
<i>Bothriochloa ischaemum</i>	5	–	–	–	–
<i>Bromus inermis</i>	–	10	5	–	–

Table 1 (continued)

Taxon	1	2	3	4	5
<i>Cerastium pumilum</i>	1	–	–	–	–
<i>Dorycnium germanicum</i>	3	–	–	–	–
<i>Eryngium campestre</i>	–	+	+	–	+
<i>Linaria genistifolia</i>	–	–	–	–	+
<i>Medicago falcata</i>	–	1	+	–	–
<i>Medicago minima</i>	–	–	+	+	3
<i>Muscari comosum</i>	–	–	–	–	+
<i>Muscari neglectum</i>	–	–	–	–	+
<i>Poa angustifolia</i>	–	–	–	1	3
<i>Potentilla recta</i>	–	–	–	–	+
<i>Teucrium chamaedrys</i>	–	–	3	3	8
<i>Vicia angustifolia</i>	–	–	–	–	+
Orno-Cotinion					
<i>Carex halleriana</i>	1	–	–	–	–
<i>Coronilla coronata</i>	+	–	–	–	–
<i>Cotinus coggygria</i>	3	–	–	–	–
Quercetea pubescenti-petraeae & Aceri tatarici-Quercion					
<i>Bupleurum praealtum</i>	–	+	–	+	–
<i>Campanula bononiensis</i>	–	–	–	+	–
<i>Dictamnus albus</i>	1	–	–	–	–
<i>Quercus pubescens</i>	+	–	–	–	1
Prunetalia					
<i>Prunus spinosa</i>	–	–	–	–	3
Secalietea, Chenopodietea & Aperetalia					
<i>Bromus sterilis</i>	–	–	–	–	3
<i>Crepis pulchra</i>	–	–	+	–	+
<i>Euphorbia cyparissias</i>	8	–	–	1	3
<i>Euphorbia salicifolia</i>	–	5	1	3	–
<i>Falcaria vulgaris</i>	–	+	–	–	1
<i>Fallopia convolvulus</i>	–	–	+	–	–
<i>Geranium rotundifolium</i>	–	+	3	–	1
<i>Myosotis arvensis</i>	–	–	+	–	+
<i>Papaver dubium</i>	–	–	1	–	–
<i>Tordylium maximum</i>	–	3	1	–	–
<i>Vicia pannonica</i>	–	–	–	–	1
<i>Viola arvensis</i>	–	–	+	–	+

05.1876. “Budapest”, Richter, L. (BP 297462); “in Monte Sancti Gerardi Budae”, 06.1890. Borbás, V. (BP 581943). **Balaton Uplands** – “Balatonalmádi: Sátor-hegy, rara, in pratis siccis, 47,05157333° 17,991565°” 31.05.2016. Bauer, N. (BP HNHM-TRA00018325). **Villány Mts.** – “Villány, Nagyharsányhegy teteje”, 16.05.1958. Nagy, I. (BP 207075); “Nagy Harsányhegy (Szársomlyó) tetején Villány mellett”, 05.1958. Nagy, I. (BP 581943); “Harsányhegy”, 1959. Nagy I. (BP 379725);

“Nagyharsány, Szársomlyó, pusztafüves lejtő” [dry grassland], 13.07.1962., Vöröss, L. Zs. (JPU); “Nagyharsány, Szársomlyó, 400 m, pusztafüves lejtő” [dry grassland], 30.05.1964., Nagy, I. and Vöröss, L. Zs. (JPU); “Nagyharsány, Szársomlyó, a csúcs alatti pusztafüves lejtőn” [dry grassland under the peak], 16.04.1966. Vöröss, L. Zs. (JPU); “Villányi-hegység: Szársomlyó”, 22.05.1997. Farkas, R. (DE Soo-41283); “Nagyharsány: Szársomlyó, in rupibus calcareis, 45,855522° 18,411116°” Bauer, N. and Márkus, A. (BP HNHM-TRA 00017567). **Pannonhalma Hills** (Sokoró) – NEILREICH (1866) cited exsiccata-matter of Ballay, but specimen is not found in the examined herbaria.

The first Hungarian data of *Medicago orbicularis* was published by SADLER (1840) from the southeast slope of the Sas Hill near Buda (“*In graminosis declivitatibus orientalis et meridionalis montis aquilarii*”) (CEU 8580.1). In the paper of BORBÁS (1879) some data from Gellért Hill were already added to the known occurrences around Budapest (8580.1). In the “*Aufzählung*” by NEILREICH (1866) some really interesting data from the Pannonhalma Hills (“*Bei Martinsberg in Com. Raab*”) were published (8472.2/8472.4/?/), and the records were based on exsiccata material (herbarium specimen) sent by Valér Ballay, Benedictine monk and teacher. The botanical chapter of Győr County Monography by FEHÉR (1874), compiled by Ferenc Ebenhöch (EBENHÖCH 1874) most probably included Ballay’s data, indicated as “*Sági hill*” site (8472.2).

After the above 19th century data, there had been no new Hungarian observations in the literature and herbariums for a long time, the only data from the vicinity of Budapest and Pannonhalma have been quoted in botanical summaries. In the absence of confirmed observations, in the monograph by JÁVORKA (1925) *Medicago orbicularis* was already described as “*very sporadic*” and then in the handbook of JÁVORKA & SOÓ (1951) it was declared “*extinct*”. In the area of Pannonhalma Hills, the species was not found despite the systematic floristic work carried out by Sándor Polgár. In the flora of Győr county compiled by POLGÁR (1941) citing the two earlier data (“*Győrszentmárton (Ball. ap. Neilr. 332), Győrság: Sági domb Ball. ap. Eb. 100.*”). He noted that the species “*úgy tűnik mostanra eltűnt*” [“it seems that the species has been disappeared by now”].

In May 1958, István Nagy found *Medicago orbicularis* (NAGY 1959) at a new site in the Villány Mountains, namely at “*Harsányhegy*” (= Szársomlyó Hill) (0176.2). At first that stand had a large number of individuals. In the 1960s, László Zsigmond Vöröss documented its occurrence several times. Based on the work by DÉNES (2000), Ákos Uherkovich found it along the road leading up to the hill in the 1970s, but the species has been retreated since then, and currently it is found only in a disturbed grassland near the top of the hill. Figure 1 shows the distribution of the species in Hungary.

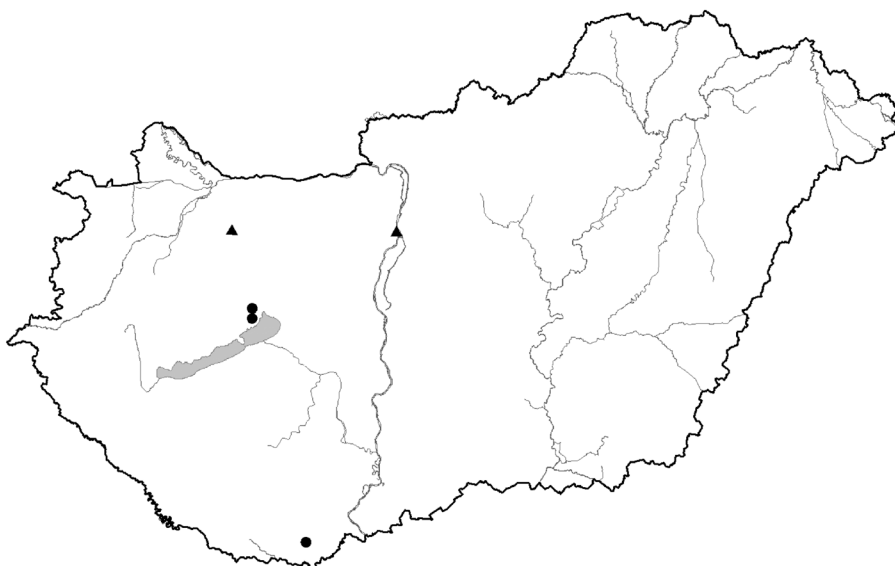


Fig. 1. Distribution of *Medicago orbicularis* in Hungary (full circles: recent populations; full triangles: former populations from the 19th Century). Depicted localities in the CEU flora mapping system: Balatonalmádi: Sátor Hill (8973.2), Budapest: Gellért Hill (8580.1), Budapest: Sas Hill (8580.1), Felsőörs: Szent-Kereszt Hill (8973.4), Pannonhalma (former: "Györszentmárton") (8472.2/8472.4/?/), Györság (8472.2), Nagyharsány: Szársomlyó (0176.1, 0176.2), Szentkirályszabadja: Alsó-telek-dűlő (8973.2).

Habitats of *Medicago orbicularis*

In the Mediterranean *Medicago orbicularis* occurs on xerothermic habitats, mainly on stony pastures, dry grasslands, maquis, open forests, agricultural fields and roadsides (MAXTED 2011).

Up to now only the colonies at Szársomlyó Hill have been studied thoroughly regarding Hungarian habitats of *Medicago orbicularis*. Soó (1966) mentioned it as *Festucion sulcatae* dry-grassland species, BORHIDI *et al.* (2012) enlisted the species at alliance of *Chrysopogono-Festucion dalmaticae* Borhidi 1996 under the characteristic southern relict elements typical of that syntaxon.

In the Balaton Uplands the grasslands providing habitat for *Medicago orbicularis* are very different. The phytocoenological relevés (Table 1) taken at the sites found on Balaton Uplands last years, represent really xerothermic, steep rocky grasslands (at Balatonalmádi) of southern and southwestern exposure, as well as degraded steppe slope (at Felsőörs), with a varying degree of disturbance in both cases. Their classification in the syntaxonomic system (BORHIDI *et al.*

2012, BAUER 2014) is as follows: 1. *Fumano-Stipetum eriocaulis* (Wagner 1941) corr. Zólyomi 1966 (degraded stand); 2–5. *Orlayo-Festucetum valesiacae* (Bauer 2012) Borhidi 2012. Common features of the two habitats include very hot temperature and disturbance. Based on the species included, both grasslands show strong Mediterranean impact, but the proportion of sub-Mediterranean and Mediterranean elements (e.g. *Allium spaercephalon* L., *Bupleurum praealtum* L., *Convolvulus cantabrica* L., *Cotinus coggygia* Scop., *Crepis pulchra* L., *Medicago rigidula* (L.) All., *Orlaya grandiflora* (L.) Hoffm., *Stipa eriocaulis* Borbás, *Tordylium maximum* L.) is not significantly higher in comparison with the dry grasslands of the area. On the Sátor Hill, Balatonalmádi, disturbance is mainly due to the treading of hiking tourists, which contributes to the constant presence of open ground surfaces on the steep slope by increasing soil erosion. In the case of the roadside stock near Szentkirályszabadja, the disturbance was mainly due to intensive bicycle tourism and moderate traffic (mainly by agricultural vehicles). In the forests of the Szent Kereszt Hill near Felsőörs, the very intensive disturbance is caused by the big game stock. Here, perhaps, the regular digging and treading by the wild boar population allowed a significant strengthening of the *Medicago orbicularis* population.

About the origin of the species in Hungary

In the past few years, several papers have discussed the spreading of Mediterranean and other thermofrequent weeds in Hungary. In case of some rare Mediterranean–sub-Mediterranean weeds, it is difficult to decide whether they are native, archeophytes, or just temporarily colonizing species, occurring occasionally (see CSIKY *et al.* 2005, MOLNÁR & CSIKY 2011). South European species, which are not native in Hungary, are seen along the main transport routes (*Plantago coronopus* – SCHMIDT *et al.* 2014, KOVÁCS & LENGYEL 2015) and in settlements (*Polycarpon tetraphyllum* – SOMLYAY & LÖKÖS 2000; *Parietaria judaica* – CSIKY 2011, TÖRÖK 2015). The joint characteristic of the recipient habitats is the strong disturbance.

Although in the case of *Medicago orbicularis* the zoochorous and anthropochorous spreading strategy is less obvious than in the case of species with thorny fruits (e.g. *M. rigidula*, *M. minima*, *M. nigra*) I consider the occurrences of the plant in Hungary adventive, just like other authors (SIMON 1992, CSIKY *et al.* 2005). This assumption is reinforced by the definitely adventive occurrences of the species far from its native area (VERLOOVE 2006, NESOM 2009).

The emergence and disappearance of the earlier (almost forgotten) Hungarian occurrences of the species are worth contemplating about. In Europe outside the Mediterranean, this is not a unique phenomenon. In the last two centuries

occasional adventive occurrences have been observed in Belgium and the Netherlands (1854 – Veurne, 1867 – Hasselt, 1956 – Kessel-Lo) around the grain silos, on agricultural lands and on road sides (VAN OOSTSTROOM & REICHGELT 1958, VERLOOVE 2018).

The documented dynamics of distribution data of the species in Hungary – its occasional emergence and disappearance – also suggests that the occurrences here are secondary, and the plant probably got to these sites by human contribution. It should be noted that the sites where *M. orbicularis* occurred at the Buda Hills were very popular excursion places as early as in the 19th century, not only for botanists but for general public (tourists) too. The introduction of the species may have taken place from the Istria peninsula or Fiume (today: Rijeka), which was a favourite holiday place for the people of Budapest at that time. Based on the data found in literature and herbaria, the species was certainly present in the Buda Hills in the 19th century for a few decades. Its presence on the Sas Hill was proven in the period between the publications by SADLER (1940) and BORBÁS (1879) for four decades, while on Gellért Hill almost two decades between the collections by Freyn in 1873 and Borbás in 1890. We have no information about the durability or duration of the taxon's presence on the Pannonhalma Hills. In the Villány Mountains, however, the species has been definitely present for more than sixty years.

Based on the distinctive sub-Mediterranean climatic conditions of the Villány Mountains and the currently stable population of *Medicago orbicularis*, it could be assumed that on the Szársomlyó Hill, along with a number of xerothermic, relict species typical at southern regions, this species is also native. However, the discovery of *M. orbicularis* here also does not suggest the nativity of it. Although, Szársomlyó is botanically one of the most extensively researched areas of Hungary, in the early botanical studies of the hill (SIMONKAI 1876, BOROS 1925, HORVÁTH 1942), the species was not mentioned, and only the local pastor found a large population of it in 1958 (NAGY 1959).

According to DUKE (1981), *Medicago orbicularis* requires warm-temperate climate with mild winters, while it is intolerant to cold winters. This statement may be one of the explanations for the disappearance of the previously known populations in Hungary, and the temporary colonisations. The actual vector of the species is unknown (VERLOOVE 2018), the spread of the species outside its native area is mysterious and has further uncertainties. Based on the experimental study by TORMO *et al.* (2006) on the spreading and colonisation of plant species, the experiment to make *Medicago orbicularis* colonisation by spraying its seed was unsuccessful even in laboratory conditions. In their experiment, the species belonged to a group in which despite the relatively high germination

potential, some other (not studied and recognized) factors are certainly needed for successful colonization.

A long-term survival of the species can be predicted on Szársomlyó Hill and perhaps at the localities of Balaton Uplands published here. The mesoclimatic features of these regions (HORVÁT 1972, BÉLL & TAKÁCS 1974, DÖVÉNYI 2010) as well as the special microclimatic features of the southern slopes (HORVÁT 1964, MÉSZÁROS & PROBÁLD 1968) and the warming of the climate of the Carpathian Basin (FEKETE *et al.* 2006, BARTHOLY *et al.* 2011) are likely to provide adequate conditions for the naturalization of the species and possibly its colonisation at new sites in the long run. At the same time, it would not be surprising either if the species disappeared from its currently known Hungarian sites.

* * *

Acknowledgements – The author would like express his gratitude to Szabolcs Varga (Pannon University, Veszprém) for exploration of the southern population at Felsőörs and his permission to publish the occurrence data and the coenological relevé taken together. I thank Zsuzsa Ballók (HNHM Mátra Museum, Gyöngyös), Lajos Balogh (Savaria Museum, Szombathely), János Csiky (University of Pécs, Pécs) and Attila Takács (Debrecen University, Debrecen) for their help in collection of data occurring in herbaria. The research was supported by OTKA (Hungarian Scientific Research Fund, No. K 108992).

Összefoglaló: Az elmúlt években a Balaton-felvidék három pontján került elő a dél-eurázsiai elterjedésű *Medicago orbicularis*. A dolgozatban az új előfordulások élőhelyi viszonyai mellett öszszegzésre kerülnek a faj magyarországi elterjedésével kapcsolatos ismereteket. A taxon korábbi hazai megfigyeléseinek (Budai-hegység, Pannonhalma környéke, Villányi-hegység) történeti áttekintésére, megjelenés–eltűnés dinamikájára alapozva feltételezhető, hogy a növényt a magyar flórában rendszeresen, de egy-egy területen általában ideiglenesen megtelepedő fajként tarthatjuk nyilván. A melegigényes, gyomjellegű faj terjedéséhez feltehetően pozitívan járul hozzá a Kárpát-medencében a klíma melegekedése és szárazodása, de az új területeken való megtelepedésében az egyre nagyobb mértékű turizmus is szerepet játszhat.

REFERENCES

- AL-ATAWNEH N., SHEHADEH A., AMRI A. & MAXTED N. (2009): *Conservation field guide to medics*. – Icarda, Syria, 214 pp.
- BARTHOLY J., BOZÓ L. & HASZPRA L. (eds) (2011): *Klímaszcenáriók a Kárpát-medence térségére*. [Climate scenarios in the Carpathian Basin]. – MTA–ELTE Meteorológiai Tanszék, Budapest, 281 pp.
- BAUER N. (2014): A Bakony-vidék szárazgyepjei – Sztyeprétek és sziklagyeppek osztályozása és növényföldrajzi karaktere. (Dry grasslands of the Bakony Region – Classification and phytogeographical character of dry and rocky grasslands). – *A Bakony természettudományi kutatásának eredményei* 33: 1–336.
- BÉLL B. & TAKÁCS L. (eds) (1974): *A Balaton éghajlata. A Balaton térségének éghajlati jellegzetességei, hő- és vízháztartása, bioklimája*. [The climate of the Balaton region]. – Országos Meteorológiai Szolgálat, Budapest, 316 pp.

- BORBÁS V. (1879): *Budapestnek és környékének növényzete*. [Flora of Budapest and its surroundings]. Különlenyomat a Magyar orvosok és természetvizsgálók 1879-ik évi vándorgyűlésére készített Budapest monographiájából. – Magyar Királyi Egyetemi Könyvnyomda, Budapest, 172 pp.
- BORHIDI A., KEVEY B. & LENDVAI G. (2012): *Plant communities of Hungary*. – Akadémiai Kiadó, Budapest, 544 pp.
- BOROS Á. (1925): A tengerpartvidéki növényzet szigete a baranyai Harsányhegyen. [Island of the seaside vegetation on the Harsányhegy (Baranya County)]. – *Term.tud. Közl.* 57: 165–166.
- CSIKY J. (2011): *Parietaria diffusa* Mert. et W. D. J. Koch előfordulása Szentendrén. – *Kitaibelia* 15: 85.
- CSIKY J., OLÁH E. & BARÁTH K. (2005): *A Medicago nigra* (L.) Krock. Magyarországon. (*Medicago nigra* (L.) Krock. in Hungary) – *Flora Pannonica* 3: 49–55.
- DÉNES A. (2000): A Villányi-hegység flóra- és vegetációkutatásának története, eredményeinek összefoglalása, különös tekintettel a védett és ritka fajok előfordulására. (History of research on flora and vegetation in the Villány Hills; a summary of results, with special regard to the occurrence of rare and protected species). – *Dunántúli Dolgozatok Természettudományi Sorozat* 10: 47–77.
- DÖVÉNYI Z. (ed.) (2010): *Magyarország kistájainak katasztere*. 2nd edition. [Cadastre of the Hungarian microregions]. – MTA Földrajztudományi Kutatóintézet, Budapest, 876 pp.
- DUKE J. A. (1981): *Handbook of legumes of world economic importance*. – Plenum Press, New York, 344 pp.
- DZYUBENKO N. I. & DZYUBENKO, E. A. (2008): *Medicago orbicularis* (L.) Bart. – In: AFONIN A. N., GREENE S. L., DZYUBENKO N. I. & FROLOV A. N. (eds): *Interactive agricultural ecological atlas of Russia and neighbouring countries. Economic plants and their diseases, pests and weeds*. Available online: http://www.agroatlas.ru/en/content/related/Medicago_orbicularis/. (Accessed: June 2018).
- EBENHÖCH F. (1874): *A megye viránya*. [Flora of the county]. – In: FEHÉR I. (ed.): Győr megye és város egyetemes leírása. Franklin-Társulat, Budapest, pp. 97–132.
- FEKETE G., BORHIDI A., KEVEY B., KIRÁLY G., KUN A., MÁTYÁS Cs., MIKA J. & MOLNÁR Zs. (2006): *Természetes növényzetünk jövője*. [The future of the Hungarian vegetation]. – In: FEKETE G. & VARGA Z. (eds): *Magyarország tájainak növényzete és állatvilága*. (The vegetation and fauna of Hungarian landscapes). MTA Társadalomkutató Központ, Budapest, pp. 397–424.
- FIORI A. (1925): *Nuova flora analitica d'Italia. I.* – Tipografia di M. Ricci, Firenze, 944 pp.
- HORVÁT A. (1942): *A Mecsekhegység és déli síkjának növényzete 1–2*. [The flora and vegetation of the Mecsek Mts and its southern foreground]. – Ciszterci Rend kiadása, Pécs, 103, 159 pp.
- HORVÁT A. O. (1964): A nagyharsányi Szársomlyón végzett mikroklímamérések eredményei. [Results of macroclimate measuring on Szársomlyó at Nagyharsány]. – *Janus Pannonius Múzeum évkönyve, Természettudományok* 9: 43–56.
- HORVÁT A. O. (1972): *Die Vegetation des Mecsek Gebirges und seiner Umgebung*. – Akadémiai Kiadó, Budapest, 376 pp.
- JÁVORKA S. (1925): *Magyar Flóra (Flora Hungarica) I–II.* – Studium, Budapest, 1307 pp.
- JÁVORKA S. & SOÓ R. (1951): *A magyar növényvilág kézikönyve I–II.* – Akadémiai Kiadó, Budapest, 1120 pp.
- KIKODZE D., MEMIADZE N., KHARAZISHVILI D., MANVELIDZE Z. & MUELLER-SCHAEERER H. (2010): *The alien flora of Georgia*. – Université de Fribourg, Fribourg, 36 pp.
- KIRÁLY G. (ed., 2009): *Új magyar fűvészkönyv. Magyarország hajtásos növényei. Határozókulcsok*. [New Hungarian Herbal. The Vascular Plants of Hungary. Identification key.] – Aggteleki Nemzeti Park Igazgatóság, Jósvalfő, 616 pp.

- KOVÁCS D. & LENGYEL A. (2015): Adatok a *Plantago coronopus* L. hazai elterjedéséhez. (Additional data to the distribution of *Plantago coronopus* L. in Hungary). – *Kitaibelia* **20**(2): 306.
- MAXTED N. (2011): *Medicago orbicularis*. – *The IUCN Red List of Threatened Species 2011*: e.T176475A7249550. <http://www.iucnredlist.org/details/summary/176475/1> (accessed: 11.07.2018).
- MEUSEL H., JÄGER E. & WEINERT E. (1965): *Vergleichende Chorologie der zentraleuropäischen Flora. Band I. Karten* – Gustav Fischer Verlag, Jena, 258 pp.
- MÉSZÁROS I. & PROBÁLD F. (1968): Lejtőtulajdonságok hatása a közvetlen besugárzás mennyiségi eloszlására. (Einfluss der Hangeigenschaften auf die Verteilung der Menge der direkten Einstrahlung). – *Földr. Értesítő* **17**(2): 249–256.
- MOLNÁR CS. & CSIKY J. (2011): A *Medicago rigidula* (L.) All. elterjedése és élőhely-választása a Pannonicumban. (Distribution and habitat requirements of *Medicago rigidula* (L.) All. in the Pannonicum). – *Kitaibelia* **15**(1–2): 35–51.
- NAGY I. (1959): Adatok Villány és környékének flórájához. [Data to flora of Villány and its surroundings]. – *Bot. Közlem.* **48** (1–2): 100.
- NEILREICH A. (1866): *Aufzählung der Ungarn und Slavonien bisher beobachteten Gefäßpflanzen nebst einer pflanzengeographischen Übersicht*. – Wilhelm Braumüller, Wien, 389 pp.
- NESOM G. L. (2009): Assessment of invasiveness and ecological impact in non-native plants of Texas. – *Journal of the Botanical Research Institute of Texas* **3**(2): 971–991.
- POLGÁR S. (1941): Györmegye flórája. Flora comitatus Jaurinensis. – *Bot. Közlem.* **38**(5–6): 201–352.
- POSPICHAL E. (1899): *Flora des Oesterreichischen Küstenlandes*. Zweiter Band. – Franz Deuticke, Leipzig und Wien, 946 pp.
- RIKLI M. (1946): *Das Pflanzenkleid der Mittelmeerländer. Zweiter Band*. – Verlag Hans Huber, Bern, 1093 pp.
- SADLER J. (1840): *Flora comitatus Pesthensis*. Editio secunda. – Kilian et Comp., Pesthina, 499 pp.
- SCHLOSSER J. C. & FARKAŠ-VUKOTINOVIĆ L. (1869): *Flora Croatica*. – Apud Fr. Župan (Albrecht et Fiedler), Zagrabiae, 1362 pp.
- SCHMIDT D., KIRÁLY G., HORVÁTH A. & SZÜCS P. (2014): Autópályán érkező tengerparti jövevény: a *Plantago coronopus* L. Magyarországon. [Incomer of the seashores arriving on highway: *Plantago coronopus* L. in Hungary]. – In: SCHMIDT D., KOVÁCS M. & BARTHA D. (eds): *X. Aktuális Flóra- és Vegetációkutatás a Kárpát-medencében nemzetközi konferencia absztraktkötete*, Nyugat-magyarországi Egyetem Kiadó, Sopron, pp. 203–204.
- SIMON T. (1992): *A magyarországi edényes flóra határozója*. [Key to the vascular flora of Hungary.] – Tankönyvkiadó, Budapest, 892 pp.
- SIMONKAI L. (1876): Adatok Magyarhon edényes növényeihez. [Contributions to the vascular flora of Hungary.] – *Mathematikai és Természettudományi Közlemények* **11**(6): 157–211.
- SOMLYAY L. & LÖKÖS, L. (2000): A *Polycarpon tetraphyllum* L. Magyarországon, és további adatok Budapest gyomflórájához. [*Polycarpon tetraphyllum* L. in Hungary and further data to weed-flora of Budapest.] – *Kitaibelia* **5** (2): 305–306.
- SOÓ R. (1966): *A magyar flóra és vegetáció rendszertani-növényföldrajzi kézikönyve II.* (Synopsis systematico-geobotanica florum vegetationsque Hungariae II.) – Akadémiai Kiadó, Budapest, 655 pp.
- TORMO J., BOCHET E. & GARCIA-FAYOS P. (2006): Is seed availability enough to ensure colonization success? An experimental study in road embankments. – *Ecological Engineering* **26**: 224–230.
- TÖRÖK P. (2015): Az adventív ágas falgyom (*Parietaria judaica* L.) újabb előfordulási adata Debrecenből. (Newly discovered locality of the pellitory-of-the-wall (*Parietaria judaica* L.) in the city of Debrecen (E Hungary). – *Kitaibelia* **20**(2): 304–305.

- URBAN I. (1873): Prodromus einer Monographie der Gattung *Medicago* L. – *Verh. bot. Vereins der Provinz Brandenburg* **15**: 1–85.
- VAN OOSTSTROOM S. J. & REICHGELT TH. J. (1958): Het geslacht *Medicago* in Nederland en België. – *Acta Bot. Neerl.* **7**: 90–123.
- VERLOOVE F. (2006): Catalogue of neophytes in Belgium (1800–2005). – *Scripta Bot. Belgica* **39**: 1–89.
- VERLOOVE F. (2018): *Manual of the alien plants of Belgium*. – accessed online: <http://alienplants-belgium.be/content/medicago-orbicularis> (Accessed: June 2018)

(submitted: 10.09.2018, accepted 05.11.2018)