Contributions to the Hungarian alien flora: *Erigeron bonariensis* L. and *E. sumatrensis* Retz. (Asteraceae) in Hungary

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Accepted: 11 November 2019

**Key words:** *Erigeron*, exotic plants, identification key, neophytes, urban flora.

**Abstract:** During a systematic survey of the flora in the administrative districts of Pécs and other Transdanubian settlements, several stands of *Erigeron bonariensis* L. and *E. sumatrensis* Retz., new species to the Hungarian flora were encountered. In this paper, we discuss the morphological and phytocoenological features of the species as well as the possible ways of their introduction. We provide an identification key for *Erigeron* species currently known in Hungary. With the changing climate and increasing human impact on the landscape, we predict the future spread and naturalization of these species in Hungary.

**Introduction**

As a result of recent flora research in Hungary, several alien plant species previously unknown to the country have been detected (SOMLYAY 2009, KORDA 2013, KIRÁLY and HOHLA 2015, KORDA 2014, KIRÁLY 2016, BÁLOGH and MESTERHÁZY 2017, TÖRÖK and ARADI 2017, CSIKY et al. 2018, KIRÁLY and KIRÁLY 2018, KORDA et al. 2018, RIEZING 2019). In other cases, the expansion of exotic species has been reported (LENGYEL 2013, LENGYEL and WIRTH 2014, MOLNÁR and JUHÁSZ 2016, SCHMIDT 2016, SCHMIDT et al. 2016, FEKETE et al. 2018, WIRTH 2018). Many of them were first noticed in human settlements or other anthropogenic habitats, or their later spread started from there (BÁTORI et al. 2012, WOLF and KIRÁLY 2014, BÁLOGH and MESTERHÁZY 2017, TAMÁS et al. 2017). The number of thermophilic species reaching Hungary from the Mediterranean region also increased in recent years (PÁL 2011, BÁTORI et al. 2012, LENGYEL and WIRTH 2014, WOLF and KIRÁLY 2014), confirming the opinion of LOSOSOVÁ et al. (2018), who postulated such tendency in urban environment due to climate change.

**Materials and methods**

The flora surveys in the administrative districts of Pécs, Harkány, Siklós, Siklós-Máriagyűd and Tihany were carried out in 2017–2019. For identification of *Erigeron* species, the keys of VERLOOVE (2019) and VLADIMIROV (2009) were used. The new identification key to the Hungarian *Erigeron* species is compiled according to the taxonomic
concept of GREUTER 2006-2018 and FUNK et al. 2009.

To characterize the habitats of the newly discovered *Erigeron* species, all co-occurring plant species in 1 m² plots were recorded. Latitude and longitude coordinates as well as elevations of the sites were calculated by GPS using WGS 84 projection. The nomenclature of species follows KIRÁLY (2009). Herbarium specimens were collected from Pécs, Síklós, Síklós-Máriagyűd and Tihany, and deposited in the Herbarium of University of Pécs (JPU). Photo documentation was also made. Numbers of grid units are given according to the Hungarian Flora Mapping Programme (BARTHA et al. 2015). The year of detection is listed in Table E1.

**Results and Discussion**

One native and two formerly established, invasive neophyte *Erigeron* species have been recorded in Hungary so far. The indigenous *E. acris* L. is a sporadic and disturbance-tolerant species, while *E. annuus* (L.) Pers. and *E. canadensis* L. are common noxious weeds throughout the country (SOÓ 1970, SIMON 2000, BALOGH et al. 2004, KIRÁLY 2009). Further *Erigeron* species of warm-temperate/subtropical origin became naturalized in some European countries in the last decades (CRONQUIST 1976, PALMER 1984, WURZELL 1988, REUTELINGSPERGER 2000, VERLOOVE and BOULLET 2001, ŠIDA 2003, GREUTER 2006-2018, FUNK et al. 2009, VLADIMIROV 2009, VLADIMIROV et al. 2016). *Erigeron bonariensis* L. and *E. sumatrensis* Retz. have been reported as newly established (VRBNIČANIN et al. 2004, ANASTASIU and MEMEDEMIN 2012, NEGREAN and CIORTAN 2012) or naturalized (POLDINI and KALIGARIĆ 2000, MILOVIĆ 2004, NIKOLIĆ 2015a,b) species in the neighbouring countries. During a systematic flora survey of the administrative districts of Pécs and other Hungarian settlements (Harkány, Síklós, Síklós-Máriagyűd and Tihany) in Transdanubia (W Hungary), two alien *Erigeron* species (*E. bonariensis*, *E. sumatrensis*), previously unknown in the country, were found in 2017–2019.

*E. bonariensis* is a greyish-green, medium sized (20–75 cm tall) annual. Its stem and leaves are densely hairy, with two types of hairs: appressed short and scattered, patent, longer hairs. The leaves are alternate, linear or linear-lanceolate, entire, 0.1–0.5 × 5–8 cm, coarsely toothed, the upper ones are shorter and linear. The synflorescence is cylindrical, with many capitula. The capitulum is (4–)5–8 mm in diameter, the involucral bracts are 3–4(–5) mm long, grayish-green with purplish apex, linear-lanceolate, acuminate and densely hairy. The apex of involucral bracts is often purplish. The number of female florets per capitula is 60–150, the laminae of ligular florets are very short (<0.3 mm) or absent. The achenes are 1–1.5 mm long, with 3–4 mm long pappus of white hairs (VLADIMIROV 2009, NEGREAN and CIORTAN 2012, VERLOOVE 2019) (Fig. 1).

**Occurrences of *E. bonariensis* in Hungary (Fig. 3):**

- Tihany: next to the paths heading to the Abbey of Tihany [9073.3]. A few dozen individuals in flower beds of *Lavandula angustifolia* Mill. and *L. × intermedia* Emeric ex Loisel. The species disappeared from this site in 2018.
- Pécs: Est utca [9975.1]. A few plants in gaps of an old pavement. This population disappeared from this site in 2019. Hajnóczy út, plant nursery [9975.1]. One specimen in an imported *Buxus sempervirens* L. pot.

*Erigeron sumatrensis* is a greyish-green, tall (up to 150–200 cm) annual. Its stem and leaves are densely hairy, with two types of hairs: appressed short and scattered ± patent,
Fig. 1. Herbarium specimen of *Erigeron bonariensis* collected in Tihany (photo by T. Wirth).

1. ábra. Az *Erigeron bonariensis* Tihanyban gyűjtött herbárium lapja (fotó: Wirth T.).
Fig. 2. Herbarium specimen of *Erigeron sumatrensis* collected at Siklós-Máriagyűd (photo by T. Wirth).

2. ábra. Az *Erigeron sumatrensis* Siklós-Máriagyűdön gyűjtött herbárium lapja (fotó: Wirth T.).
longer hairs. The leaves are alternate, the lower ones are elliptic-lanceolate to oblong-ovate, petiolate, remotely dentate (with 3–6 teeth on each side), the middle ones are linear-lanceolate to linear, 0.6–1(–1.2) × 4–10 cm, ± entire, the upper ones are shorter and narrower, sessile. The synflorescence is rhombic in outline, with many capitula. The capitulum is (4–)5–7 mm in diameter; the involucral bracts are grayish-green, linear-lanceolate, acuminate, densely hairy. The apex of involucral bracts is green. The number of female florets per capitula is 130–200, the whitish laminae of ligular florets are very short, less than 0.5 mm (inconspicuous). The achenes are 1–1.5 mm long, with 4–5 mm long pappus of pale brown hairs (Vladimirov 2009, Anastasiu and MemeDEMiN 2012, Verloove 2019) (Fig. 2).

Occurrences of E. sumatrensis in Hungary (Fig. 3):
– Pécs: Siklósi út [9975.1]. One specimen in the garden of the city management company with other thermophilous alien plants (e.g. Euphorbia prostrata Aiton and E. serpens Kunth). This specimen disappeared soon, due to intensive mowing and other gardening activities.
– Siklós-Máriagyűd: along the pathway next to the pilgrimage church [0175.2]. Two small specimens in cracks of flagstones and one fairly developed individual in a rainwater ditch. The latter individual was planted into a plastic pot by the first author in 2018 and was raised to flowering stage in 2019.
– Siklós: in the vineyards of Tenkes Hill, between the road leading to the quarry and Siklós-Máriagyűd village [0175.2]. Thousands of individuals occur here in various habitats (roadsides, open surfaces, vineyards, lavender fields).
– Harkány: Szőlőhegy [0175.1]. A few dozen specimens in a vineyard.
Both species occurred in strongly disturbed habitats in urban environment. *Erigeron bonariensis* preferred dry pioneer surfaces (flower beds with mulch, planting pots) shared by only a few accompanying species, while *E. sumatrensis* occurred mainly in relatively species-rich vineyards and along high-traffic roads, often together with *E. annuus* and *E. canadensis*. The aforementioned habitats of *E. sumatrensis* can be described as disturbed, early successional, pioneer surfaces with dry conditions or plant communities characteristic to neglected and abandoned vineyards. An example for such a habitat is *Erigeronto-Lactucetum serriolae* Lohmeyer in Oberd. 1957 (PÁL 2007) which is indicated by the accompanying species (for details see Table E1).

We suggest the following key to distinguish *Erigeron* species currently known to Hungary:

1a Laminae of ligular florets conspicuous, at least 2 mm long. Ligular florets usually less numerous than tubular florets ...........................................2

1b Laminae of ligular florets inconspicuous or absent, 1 mm long at most if present. Ligular florets usually more numerous than tubular florets...........................................3

2a Laminae of ligular florets radiant, at least twice as long as involucral bracts, 6–8 mm long, white or pale blue. Synflorescence is a corymbose panicle. Capitulae 12–20 mm in diameter. Basal and lower cauline leaves usually ovate, coarsely dentate, upper leaves lanceolate, entire. Leaves with sparse appressed hairs. Basal rosette withered at anthesis. ([*Stenactis annua* (L.) Less.])

2b Laminae of ligular florets erect, not radiant, slightly longer than tubular florets, 2–4 mm long, lilac. Synflorescence is a corymbose or elongate panicle. Capitulae 5–15 mm in diameter. Basal leaves narrowly elliptical to obovate, entire or rarely slightly serrate. Cauline leaves lanceolate. Stem and leaves with dense, crispate hairs. Basal rosette present at anthesis. *E. annuus* L.

3a Upper surface of leaves glabrous (or only with scattered hairs along the midrib), leaf margins distinctly ciliate. Synflorescence broadly columnar (or ± rhombic) in shape. Capitulae 2–4 mm in diameter. Involucral bracts almost glabrous or with scattered hairs. Laminae of ligular florets present, erect, 0.5–1 mm long, white. Pappus brownish. ([*Conyza canadensis* (L.) Cronquist])

3b Upper surface of leaves densely shortly pubescent, leaf margins not or very shortly ciliate. Synflorescence rhombic in outline or broadest in the upper part. Capitulae (4–)5–7–(8) mm in diameter. Involucral bracts densely hairy. Laminae of ligular florets absent or inconspicuous ...........................................4

4a Leaves narrow, less than 5 mm wide, the uppermost ones linear. Synflorescence reverse pyramidal, the side branches overlapping the main axis. Capitulae (4–)5–8 mm in diameter. Apex of involucral bracts purplish. Ligules absent. Pappus whitish. ([*Conyza bonariensis* (L.) Cronquist, *C. ambigua* DC.])

4b Leaves wider, 3–20 mm wide, never linear. Synflorescence rhombic in outline, the side branches never overlapping the main axis. Capitulae (4–)5–7 mm in diameter. Apex of involucral bracts green. Ligules very short, less than 0.5 mm long, inconspicuous (not exceeding the involucres). Pappus brownish. ([*Conyza sumatrensis* (Retz.) E. Walker, *C. albida* Willd. ex Spreng.])

*Erigeron bonariensis* and *E. sumatrensis* have not been published from Hungary so far. These species probably were introduced to the country either by the soil of ornamentals (see HOSTE et al. 2009) or by human visitors (the Abbey of Tihany and the
pilgrimage church in Máriagyűd are top tourist destinations), or even by vehicles (to quarries).

Revisiting the previously discovered populations of *E. bonariensis* in 2018 in Tihany and 2019 in Pécs, we did not find the species again in its original localities. The disappearance probably was caused by an intensive agricultural management practice (Tihany) or weed control of pavements (Pécs). Therefore, *E. bonariensis* is currently considered a casual alien in the flora of Hungary.

Only four specimens of *E. sumatrensis* were encountered in Siklós–Máriagyűd and Pécs cities. The simultaneous occurrence of other alien thermophilous plants (e.g. *Ecballium elaterium* L., *Euphorbia prostrata* Aiton, *E. serpens* Kunth), suggests that microclimato logical conditions are appropriate for the species to survive in situ. The thousands of specimens observed in a relatively large area in the vineyards of Siklós and Harkány indicate an earlier but uncertain introduction. *Erigeron sumatrensis* is therefore considered fully established in this part of the Villány Hills. The species may have originally spread from a private collection of ornamental and Mediterranean food plants located at the end of an unnamed dirt road of Siklós vineyards, where we observed the species for the first time. In that collection, numerous other plant species native to warmer climates (*Actinidia* spp., *Diospyros kaki* L. f., *Ficus carica* L., *Punica granatum* L., *Quercus coccifera* L., *Q. ilex* L., *Q. suber* L., etc.) can be found. The propagules of *E. sumatrensis* may have arrived there in earth-balls of plants or via the vehicles transporting them years ago. *Echinaria capitata* (L.) Desf., another alien species with Mediterranean origin, also appeared along a nearby dirt road earlier (Pál 2011). After checking the southern slopes of Villány Hills potentially appropriate to the establishment of the species, we found that *E. sumatrensis* occupied an app. 1 km² area in 2019. Given the local abundance of the species, we expect its further spread in Baranya County.

Taken together these facts and considering the existing population of *E. bonariensis* in the neighbouring Croatia, close to the Hungarian border (Nikolić 2015a) as well as the established populations of *E. sumatrensis* in South Hungary, the future appearance or further spread of *E. bonariensis* and *E. sumatrensis* cannot be ruled out in climatically favourable (warmer) parts of Hungary. Moreover, the occurrence of other neophytes [e.g. *Eleusine indica* (L.) Gaertn., *Euphorbia prostrata* Aiton, *E. serpens* Kunth, *Polycarpum tetraphyl lum* L., *Rostraria cristata* (L.) Tzelev] in the same urban habitats convey the suggestion that stands of the summer-dry trampled vegetation of *Polycarpo-Eleusinion indicae* Čarni et Mucina 1998 (Čarni and Mucina 1998) are still present in Hungary.

**Acknowledgements**

We thank the anonymous reviewer and especially Tibor Kalapos, Lajos Somlyay and Júlia Tamás for their many insightful comments and suggestions. The project was supported by the European Union and co-financed by the European Social Fund: Comprehensive Development for Implementing Smart Specialization Strategies at the University of Pécs (EFOP-3.6.1.-16-2016-00004).
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Kiegészítések a magyarországi adventív flórához: az Erigeron bonariensis L. és az E. sumatrensis Retz. (Asteraceae) Magyarországon

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Elfogadva: 2019. november 11.

Kulcsszavak: Erigeron, határozókules, idegenhonos növények, neofitonok, urbán flóra.

Összefoglalás: Pécs közigazgatási területének szisztematikus flóratérképezése és egyéb du-nántúli települések növényzetének vizsgálata során a hazai flórára új Erigeron bonariensis L. és az E. sumatrensis Retz. néhány állományára bukkantunk. A szerzők a két faj morfológiai jellemzői mellett az egyes fajok cönológiai jellemzőiről, a behurcolódásuk lehetséges módjaiból nyújtanak információkat, valamint a hazai Conyza canadensis L.-vel való könnyű összetéveszthatóság miatt új hazai Erigeron határozókulescot adnak:

1a A nyelves virágok lemeze látható, ≥ 2 mm. A nyelves virágok száma általában jóval kevesebb a csöves virágoknál. ........................................................................................................... 2

1b A nyelves virágok lemeze nem látható v. hiányzik, ha megyen akkor ≤ 1 mm ......................... 3

2a A nyelves virágok lemeze fejlett, legalább 2× hosszabb a fészekpikkelyeknél, 6–8 mm hosszú, fehér v. halványkék. Az összetett virágzat sátorszerű. A fészek 12–20 mm Ø. A tő- és alsó szárlevél ált. tojásdad, ritkásan fogas, a felső szárlevél lányszalag, ép szélű. A levél ritkásan rányomott szőrű. A tőlevélrózsa virágzásra elszárad. [Senectis annua (L.) Less.]

Erigeron annuus L.
Erigeron bonariensis and E. sumatrensis in Hungary

2b A nyelves virágok lemeze felálló, nem sugárzó, kissé hosszabb a csöves virágoknál, 2–4 mm hosszú, liliás színű. Az összetett virágzat fürtős buga. A fészek 5–15 mm Ø. A tőlevél keskeny-elliptikus, ovális, ép szélű v. távol aprón fogas. A szárlevel lándzsas. A szár és a levelek sűrű göndör szőröseke. A tőlevélrózsa virágzáskor még megy van. **E. acris** L.

3a A levél színi oldala kopasz (v. legfeljebb a főér mentén ritkán szörös), a levélszel pillásan szörös. Az összetett virágzat széles hengeres (v. ± rombusz) alakú. A fészek 2–4 mm Ø. A fészkekik kelyek majdnem kopaszak v. ritkán szörösek. A nyelves virágok lemeze megvan, felálló, 0.5–1 mm hosszú, fehér. A bóbita barnás színű. [**Conyza canadensis** (L.) Cronquist]

**E. canadensis** L.

3b A levél színi oldala sűrűn aprón szörös, a levélszel nem v. rövid szörökönél pillás. Az összetett virágzat rombusz alakú v. a felső részén a legszélesebb. A fészek (4–)5–7(–8) mm Ø. A fészkekik kelyek sűrűn szőrösek. A nyelves virágok lemeze hiányzik v. nem látszik.................................4

4a A levél keskeny, legfeljebb 5 mm széles, a legfelsők szálasak. Az összetett virágzat fordított háromszög alakú, az oldalsó virágzati ágak a fő virágzati tengelyt túlnövik. A fészek (4–)5–8 mm Ø. A fészkekik kelyekcsúcsa liliás színű. A nyelves virágok lemeze hiányzik. A bóbita fehéres. [**Conyza bonariensis** (L.) Cronquist]

**E. bonariensis** L.

4b A levelek szélesebbek, 3–20 mm szélesek, sosem szálasak. Az összetett virágzat rombusz alakú, az oldalsó virágzati ágak sosem növik túl a fő virágzati tengelyt. A fészek (4–)5–7 mm Ø. A fészkekik kelyekcsúcsa zöld. A nyelves virágok lemeze nagyon rövid, ≤ 0.5 mm hosszú, nem látható (nem éri el a fészkekik kelyekcsúcsát). A bóbita barnás. [**Conyza sumatrensis** (Retz.) E. Walker]

**E. sumatrensis** Retz.

A fajok lehetséges behurcolása az ültetett dísznövények földlabdájával, az ezeket a növényeket szállító járművekhez tapadva, illetve a helyszínenek megforduló nagyszámú turista és megnövekedett gépjárműforgalom révén történhetett. Mindkét újjonnan megtalált faj jellemzően településekben vagy azok környékén, általában száraz, pionír jellegű élőhelyeken (virággáté és cserépek, úszsegélyek, szőlőültetvények) került elő. A két faj közül az **E. bonariensis** eddig megtalált hazai lelőhelyein alkalmi megtelepedő fajnak bizonyult, míg az **E. sumatrensis** meghonosodottaknak tekinthető, főleg a Villányi-hegység szőlőültetvényeiben. A szerzők szerint e fajok további megtelepedése és terjedése hazánkban a klímaváltozás és az emberi tevékenységek miatt igen valószínű.
