

***Eleusine indica* (L.) Gaertn., new species of the adventive flora of Slovakia**

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Abstract: First two records of *Eleusine indica* in Slovakia are presented. This exotic grass species originating from the tropical Old World was found in the Podunajská nížina Lowland (*Eupannonicum*): in 2017 in Štúrovo and the next year in Bratislava, municipal part Karlova Ves. Both populations counted only three individuals grown in the pavement cracks. The habitat conditions of each locality in detail are characterized. Whereas Slovakia is among the last countries where *E. indica* was just discovered within Europe, we discuss the environmental conditions and the origin of the species in the backlight of earlier studies related to its occurrence in the surrounding countries.

Key words: urban ecosystems, roadsides, new record, *Eleusine indica*, casual alien, plant invasion

Introduction

Eleusine indica is a late summer annual grass. Its long, spreading spikes resemble goose feet. Confusion with other grasses of digitate inflorescence (e.g. with *Digitaria* or *Cynodon*) is possible, but *E. indica* 's flattened culms, bright green leaves, size of many-flowered spikelets, and lack of awns serve to distinguish (Clayton et al. 2006).

The geographical origin of *E. indica* is uncertain due to its worldwide expansion, but it is considered native to the tropical regions of the Old World (Eastern Africa). This exotic grass is naturalized in Portugal (incl. Azores), Spain, France, Italy and it is casual in Great Britain, Netherlands, Austria, Croatia, Slovenia, Hungary, Serbia, Romania and Bulgaria (Hansen 1980). It is listed as fifth among the ten worst word's weeds as a serious, dominant agricultural weed (Holm et al. 1977). *E. indica* occupies in Europe disturbed habitats such as roadsides and fields. The most frequently is reported in urban areas (e.g. pavements, parking lots, dump stations).

There are no any published data or mention of *E. indica* in Slovakia (Medvecká et al. 2012). As a strong competitor species, it is a member of the casual adventive flora of the surrounding countries. In the Czech Republic the first record was published by Dvořák & Kühn (1966), under the synonym *E. japonica*. It was found in 1963 near Brno in the gardening colony among other ruderal plants growing on the fertilized soils originating from the sludge after cleaning Australian raw wool in the nearby factory Mosilana. A later record from the Rybárska Street from the outskirts of Olomouc (in 1984) due to its incorrect determination was stored under the genus *Digitaria* (Kubát 2008). Other specimens found between years 1974 and 1998 around food factories in Kolín and Ústí nad Labem are related to oil and soy production imported from abroad (Jehlík 1998). Otherwise, it is not the only species of the genus occurring in the Czech Republic, as some of the older records of *E. indica* were determined to *E. coracana* (also an annual plant, grown for grain) and to *E. tristachya* (Kaplan 2014).

Similarly in Austria, where the perennial *E. tristachya* is also present, *E. indica* is known from 1969. Today it spreads in the eastern and south-eastern regions of the country. It has rich stands in Vienna: e.g. at several micro-sites around the large building of the Museum of Natural History, on a trash dump at the Schwechat Airport, and it is also reported in Steiermark, along the track at the grain silo (Wallnöfer 2014).

In Poland the species was firstly recorded in the 1930s (Urbisz 2011); in Szczecin at garbage dump near the oil mill and on field verges, recent record is in Katowice from roadsides (p. 131 from Urbisz l.c.).

In Hungary the first observation of *E. indica* was reported by Polgár (1918) from Győr and later from other larger cities such as Budapest (Pénzes 1929), Szeged (Timár 1948), Debrecen (Pfeiffer 1998), as well as in smaller settlements like Budakalász or Esztergom (Barina & Schmidt 2004). Recently it is massively expanded in several regions throughout the country (Dancza 2012) and according to the latest detailed study dealing with its gradual expansion and coenological

preferences, it occurs in all districts of Budapest, locally in very rich populations (Csontos et al. 2017).

Such naturalizing process is in the southern countries of Europe, e.g. in Romania, where the first report of *E. indica* was from Iași in 1957 via seeds of *Lolium perenne* used for lawns. To the invasive capacity of the species due to its large distribution in the country (Ciocârlan 2009) noticed Culiță et al. (2011). Similar wide-spread distribution is in Croatia (Pandža et al. 2001) where in the 1970s *E. indica* had four distant localities in inland and coastal regions as well (Topić & Šegulja 1978).

Whereas Slovakia is one of the last European countries where *Eleusine indica* has just appeared (or has been noticed), we summarize and compare the environmental conditions and the origin of the species taking into account other studies published from the surrounding countries dealing with its various occurrences.

Material and Methods

The studied plant species, *Eleusine indica* (L.) Gaertn (family Poaceae) is a caespitose, annual species. Its habit is prostrate and spreading, culms ascending or erect to about 40 cm. Leaves are glabrous and bright, fresh green in colour. Ligule is a very short membraneous rim up to 1 mm long, sparsely fringed with short hairs. Sheaths and stem bases are distinctly flattened. The inflorescence consists of 3-8 racemes, each 5-10 cm long, about 5 mm wide, arranged more-or-less digitately, though one raceme may be inserted about 1 cm below the others. Narrow rachis, about 1 mm, has two dense rows of almost glabrous spikelets, each 2.5-3 mm long, 3-5 flowered, the lower and upper glumes about 1.5 and 3 mm long, respectively, and the lemmas very similar in both texture and size to the upper glume. All have a slightly scabrid keel and are acute but not awned. The reddish-brown to black seeds are oblong, about 1 mm long, conspicuously ridged (Clayton et al. 2016).

Field observations were conducted in several times between February, 2017 and September, 2018 in the towns of Bratislava and Štúrovo. The collected voucher specimens of *Eleusine indica* are deposited in the herbarium of the Slovak Academy of Sciences (SAV). Quadrant numbers are given according to the Central European Flora Mapping System (Niklfeld 1971). The phytogeographical classification of Slovakia is considered according to the work of Futák (1984). Nomenclature of flowering plants follows Marhold (1998).

Results

Even though *Eleusine indica* has been known for a long time in the Czech Republic Austria and Hungary, in Slovakia it was discovered only in 2017. We have found it in the town of Štúrovo on the Széchenyiho street near the Bridge of Mária Valéria leading to Hungary (Podunajská nížina, 8278a). The population counted three individuals (two bigger and one small) growing on the edge of the pavement between the curb and the lawn. Although the time of the first record (February) was out of the vegetation season, the shrivelled fertile plants from the previous year were easily determinable (Fig.1, left picture). In the vegetation period in 2017 we have not found any specimen, only in 2018, when two individuals were observed on the same place (Fig. 1, right picture). The surrounding accompanying species were *Poa annua*, *P. compressa*, *Trifolium repens*, *Cynodon dactylon*, *Lamium purpureum*, *Taraxacum* sect. *Ruderalia*, *Capsella bursa-pastoris* and *Erodium cicutarium*, many of them typical to the trampled vegetation of the class *Polygono arenastri-Poetea annuae* Rivas-Mart. 1975 corr. Rivas-Mart. et al. 1991 (Jarolímek et al. 1997).



Fig. 1. *Eleusine indica* in Štúrovo, Széchenyi Street (4. 3. 2017 and 27. 7. 2018, Daniel Dítě).

The second site of *Eleusine indica* in Slovakia has been found in May 2018 in Bratislava, municipal part Karlova Ves, Karloveská street (Podunajská nížina,

7868a), on the edge of pavement, close to the back entrance No. 21 of the block of flats (Fig.2). Two flowering plants most probably originated from the seeds of bird's food from the cage situated on the nearby balcony, similarly as one plant of *Panicum miliaceum*. In the close vicinity of the habitat of *E. indica* there was a large population of *Commelina communis*, which is widely spreading in the neighbouring plots. On the adjacent neglected flower bed were recorded wild growing species: *Amaranthus lividus*, *Portulaca oleracea*, *Poa annua*, *Setaria pumila*, *Stellaria media*, *Erodium cicutarium*, *Capsella bursa-pastoris*, *Rumex patientia*.



Fig. 2. *Eleusine indica* in Bratislava, Karloveská Street (28. 5. 2018, Pavol Meredá jun.).

Discussion

As the origin of the new stand of *E. indica* in Štúrovo we consider the closest known site in the neighbouring town Esztergom, Hungary. There were recorded a few individuals in pavement crevices (Barina & Pifkó 2007) near the bus station of the town. In August, 2018, during a detailed observation of the surrounding streets published in the above mentioned work, we have found hundreds of fertile individuals in the same habitat circumstances, other preferable places were the gaps between the cobble stones. The occurrence in Štúrovo might be the result of the traffic revival between Esztergom and Štúrovo after the reopening the Mária Valéria Bridge in 2001. Due to the impermanent presence it is not excluded that *E. indica* was there (or elsewhere) earlier.

E. indica in Central Europe occurs outside of urbanized areas as well, in more natural conditions. We have recorded it in the exposed, gravel-sandy banks of the Danube river in Esztergom, Szentgyörgymező in periodically flooded ruderalized vegetation (Dítě & Dítě 2018, ined.). This is not the only known natural habitat of the species in Hungary, there are similar observations as well (Barina & Schmidt 2004).

Another recent example of its escape into the wild was reported by Sádlo & Marek (2018) in the Czech Republic. The latest major summer floods of the Vltava River in 2013 resulted a rapid development of thermophilous exotic species on the fine river sediments around Prague; among *E. indica* were found for instance *Chenopodium quinoa* or *Salvia hispanica* (known as chia seeds) popular representatives of the today's healthy diet. Their field observations (Sádlo & Marek 2018) confirmed that these species together with *E. indica* can be abundant in localities where fallen seed mixture remains on the ground, e.g. under the balconies with parrot feeding. The second record of *E. indica* in Bratislava described above is a very similar case.

In Slovakia, we assess the invasion status of *E. indica* is casual. All occurrences of *E. indica* in Central Europe are related to food processing and storage (rather earlier records before 1980) or transportation (rather recent cases), the natural way of spreading (e.g. along river beds) is less common yet. Taking into account the experiences from other countries, the spread of alien weeds in a larger extent is expectable in the future. In Slovakia, some thermophilic weeds (*Dittrichia graveolens* and *Euphorbia prostrata*) have already appeared in larger towns or motorways thanks to the local heat effect (Király et al. 2014). These attempts are not always successful, since the majority of late summer exotic newcomers are often being recorded only once then they rapidly disappear, since they are unable to produce seeds due to the cooler climate in the late growing season in Central Europe (Frey 2010; Csontos et al. 2017; Sádlo & Marek 2018). Nevertheless, spontaneous occurrence and naturalization of invincible weeds outside of man-made habitats is going to be a general phenomenon, not only due to the increasing traffic. The higher mean and extreme temperatures measured in the latest years provide also better life conditions for them.

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