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Lepidium oblongum (Brassicaceae) appeared on Hungarian railways: the beginning of a wider European conquest?

Dávid Schmidt[1*], Attila Mesterházy[2], János Csiky[3]

[1] Sopron University, Department of Botany and Nature Conservation, H-9400 Sopron, Bajcsy-Zsilinszky u. 4, Hungary

[2] Centre for Ecological Research, Wetland Ecology Research Group, H-4026 Debrecen, Bem tér 18/C, Hungary

[3] University of Pécs, Department of Ecology, H-7624 Pécs, Ifjúság útja 6, Hungary

Abstract – *Lepidium oblongum,* of American origin is a new member of the European adventive flora, only detected in Romania so far. The first Hungarian stand was discovered in 2018, and others in 2020. Based on our studies, we detail its morphological characteristics in comparison with other *Lepidium* species. We present a new drawing and a table to help identify the species. *Lepidium oblongum* is easily identifiable by its divided (lobed or lobed-dentated) upper stem leaves. By analyzing selected climatic parameters we show that the new European habitats are found in the drier and cooler summer subtype of the humid continental climate belt. In Hungary, it spreads directly along the railways. The establishment of individual populations can be influenced by the location of cargo unloading and the movement of railway workers. *Lepidium oblongum* occupies gravelly, sun-exposed habitats along Hungarian railway tracks such as loading platforms, guardhouses and goods stations. Based on its high stress and climatic tolerance and initial spread-rate, it is consider to be a naturalized member of the European adventive flora, that could be potentially invasive along the European railways.

Keywords: alien species, *Lepidium*, naturalization, railway track, stress tolerance

Introduction

Lepidium L. is a cosmopolitan genus of about 220 species distributed on all continents except Antarctica (Al-Shehbaz and Gaskin 2010). It is one of largest and most readily distinguishable of all genera in the Brassicaceae family. Recently, based on molecular studies, the genera *Coronopus, Stroganowia* and *Cardaria* were merged within *Lepidium* (Al-Shehbaz 1986), but this view was not adopted by most European flora papers.

According to De Carvalho e Vasconcellos et al. (1993) the genus *Lepidium* is represented in Europe by 23 species. Of these, 7 are alien taxa: *L. bonariense* L., *L. densiflorum* Schrad., *L. neglectum* Thell., *L. oblongum* Small, *L. virginicum* L. are American adventive, *L. sativum* is native to Northeast Africa and Asia Minor, while *L. africanum* is an African flora element (De Carvalho e Vasconcellos et al. 1993, Sîrbu and Oprea 2011, Kaplan et al. 2018). Nearly all of them are considered to be among the most widespread adventive species in Europe (De Carvalho e Vasconcellos et al. 1993, Lambdon et al. 2008), excluding *L. neglectum* (which is often evaluated only as a subspecies of *L. densiflorum*) and *L. oblongum*, which has only emerged in Europe in the last decade.

Lepidium oblongum Small (syn.: *L. greenei* Thell., *L. bipinnatifidum* auct. non Desv.) was described by John Kunkel Small in the Flora of the Southeastern United States (Small 1903). The locus classicus is in northeastern Oklahoma. Based on differences in the shape of the fruit and the lower surface of the pedicels, var. *insulare* C.L. Hitchc. can be separated from var. *oblongum* (Small 1903).

According to Al-Shehbaz and Gaskin (2010), the native area of *L. oblongum* includes the Western (Arizona, California, New Mexico) and South Central United States (Texas, Oklahoma, Arkansas, Lousiana, Mississippi) and the southern states of the Midwest (Kansas, Missouri) (Kartesz 2015). Moreover, the USDA NRCS (2020) also listed it as a native of the southern part of Nebraska and

* Corresponding author e-mail: schmidt.david@uni-sopron.hu

Georgia. It is widespread in California and the southwestern states, but very rare in the eastern limit of its natural range in Arkansas and Louisiana (Al-Shehbaz 1986, Rollins 1993). Beyond that, it can be found as a native all over Mexico (including Guadalupe Island), and extends to the northern part of Central America (El Salvador, Guatemala, Honduras) (Al-Shehbaz and Gaskin 2010).

Outside of its native distribution range, it was recorded in a few states of the United States, specifically from the southern part of the Midwest (Wilder and McCombs 2003). Based on herbarium data from the last two decades, there is evidence of a definite spread towards the north. Herbarium sheets confirm its establishment in the Midwestern States (Keener et al. 2020, Shaw et al. 2020), as well as in the Pacific Northwest (Swbiodiversity 2021). Al-Shehbaz (1986) reported it as a newly introduced wool alien in South Carolina. Rollins (1986) published from Hawaii Islands, where it occurs as a naturalized alien, in dry, disturbed sites, between 0 and 200 m.a.s.l. (Wagner et al. 1999). Hewson (1981) listed it as a rare casual species in Australia. Its single European indication appeared recently: the species was found at the railway station of Râmnicu Sărat (Buzău County, Eastern Romania) on 16 May 2011 and 1 June 2011 (Sîrbu and Oprea 2011), and was repeatedly observed until 2015 (C. Sîrbu ex litt.). It is not known from Asia, Oceania, South America and Africa so far.

In the southwestern states of the United States (Texas, New Mexico, Arizona) and northern part of Mexico's semidesert grasslands (prairies, 'llanos'), the species is referred as a characteristic for scrubs (Carnahan 2020). In California and the Baja California Peninsula area it is a member of the Mediterranean climate coastal sage scrub, a succulent scrub that also appears in the eastern, arid climate zone of the peninsula (Sierra de la Giganta) (Rebman et al. 2016). In the Los Coronados Islands of Baja California, it is a member of the maritime succulent scrub vegetation (Oberbauer 2001) often growing together with cacti.

In its native area, the species also occurs in a wide range of habitats that are often affected by anthropogenic disturbance, often trampled vegetation, dry or prone to dehydration (e.g. between pavement cracks – Keil et al. 1985, Char 1997). For most of the year it prefers dry, sandy soils, however it also lives on occasionally flooded, muddy riverbanks. In Texas, Waller (1968), in California, Rollins (1993) report its occurrence on sandy roadside verges ("wayside peppergrass"). In southern Arizona, it prefers horizontal, gently sloping, or slightly depressed ground, in sandy or gravelly soils, and often in broad seasonal watercourses or at the margin of stock ponds for cattle (S. Carnahan ex litt.). Flores-Olvera et al. (2016) indicated its occurrence in saline lake beds of inland saline areas as well as mangroves along the Atlantic coastline of Mexico. Several publications report that it can be found also in dry, open oak forests ("Madrean encinal") (Medina Lemus and Tejero-Díez 2006, Carnahan 2020).

Its introduction by traffic to various American states can be clearly inferred from notes on herbarium sheets. It began to spread eastward from the southern states of the USA (North Virginia, Al-Shehbaz 1986) and then in the north-northeast direction a new wave of propagation began from the 2000s, which can be traced on the basis of herbarium specimens. Specimens have been collected in anthropogenic environments, almost exclusively from roadside habitats in Kentucky, Tennessee (Shaw et al. 2020), Alabama (Keener et al. 2020) and Indiana (Swbiodiversity 2021). Currently its northernmost known collection site is in Cleveland, Ohio, where it was found as an occasionally established settler on a railway embankment (Wilder and McCombs 2003). However, in the west coast of the United States, it penetrates much further north, and naturalized populations have been found in Washington state (Skagit County) in roadside and riverside vegetation (Swbiodiversity 2021).

More detailed information on its area of non-native distribution has been provided from the Hawaiian Islands. Research conducted along a motorway on the island of Maui has shown that the species becomes dominant in low-lying dry, disturbed areas where grazing animals rest under the shade of *Prosopis pallida* (Willd.) Kunth individuals (Char 1997). Lorence et al. (1995) mentioned it as a common weed in the lawn of a park near the sea in the island of Kauai.

Starr et al. (2006) found it in an association with *Sida fallax* Walp. and *Erythrina sandwicensis* Degener whose characteristic habitat is found in the drier areas of the sandy soils on the islands. As a newly introduced element in various states of the United States, it usually grows on dry, compacted, silty soil on the edge of roads or railways (Swbiodiversity 2021). The Romanian population appeared along a railway line (Sîrbu et al. 2014).

The main objective of our study was to introduce morphological and ecological characteristics of the species, based on its first experiences in Hungary. Our aim was to analyze the associated environmental factors, especially its climate needs.

Materials and methods

The field studies were conducted between 2018 and 2020. The Central European Unit grid numbers for the locations are given in brackets according to the Central European Flora Mapping Scheme (Niklfeld 1971). For the assessment of the distribution of the studied species in the United States, we used the maps from Swbiodiversity (2021) and Kartesz (2015). Herbarium vouchers collected by the authors are stored in herbaria BP and JPU. Nomenclature of all taxa follows TPL (2013). Morphometric comparative data (for all species investigated in the study) is based on the specimens collected in Szombathely and are compared with the data in the identification key of De Carvalho e Vasconcellos et al. (1993) and Al-Shehbaz and Gaskin (2010). We examined its climate demands in relation to the viability of the species in Hungarian habitats. Climatological data are from the website of the National Weather Service (USA) (https://w2.weather.gov), the sampling network of National Meteorological Service (Hungary), National

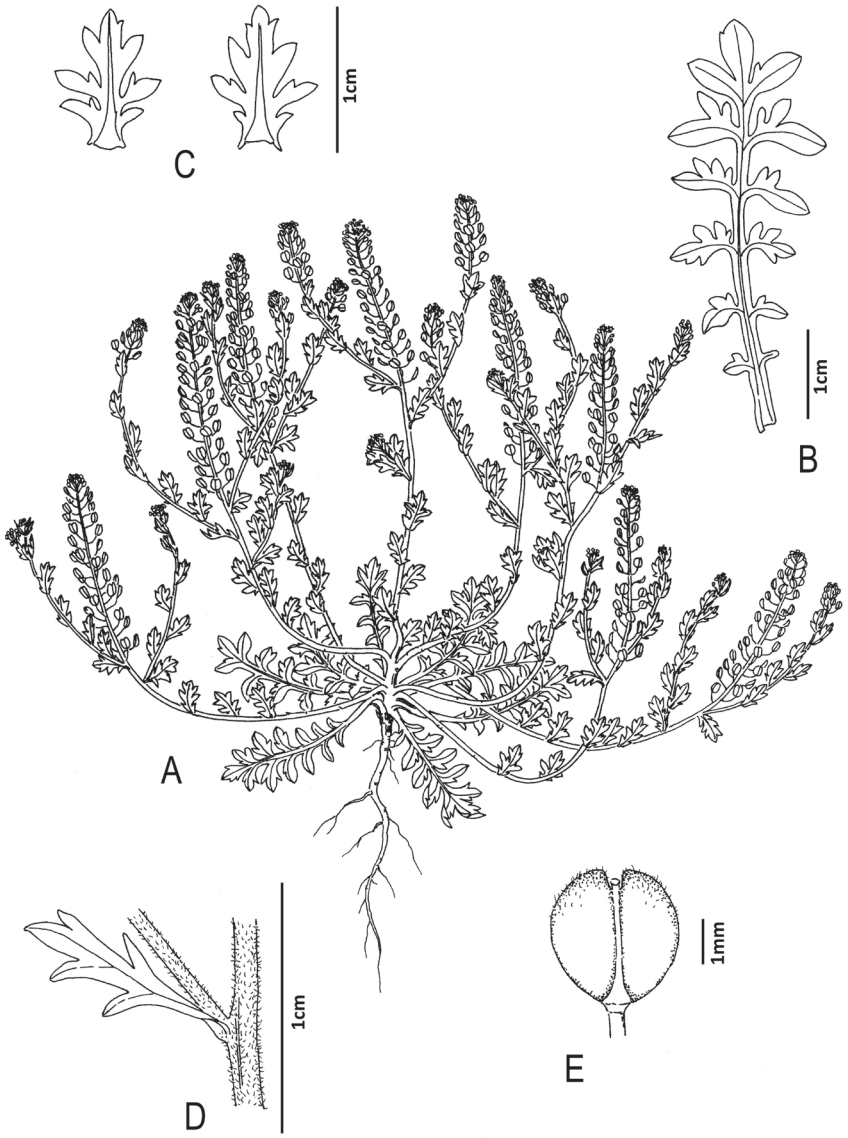

Fig. 1. *Lepidium oblongum* Small. A – habit, B – basal leaf, C – upper cauline leaf, D – stem, E – silicle. Drawing by Jana Táborská.

Meteorological Service (Mexico) (https://smn.conagua.gob.mx) and from ogimet.com (Romania).

Lepidium oblongum is a small sized annual. Its stem is ascending to erect, 5–30 cm tall, often branched from base, pubescent with cylindrical hairs (Fig. 1). Basal leaves not rosulate, petioles are 1–3 cm, 1–2 × pinnately divided, 0.7–3 cm long. Cauline leaves usually sessile (rarely shortly petiolate), at the base auriculate or not, 1–2 × 0.2–0.9 cm, margins dentate to pinnately lobed or laciniate, sparsely pubescent. Inflorescences are many elongate (3–9 cm long) racemes, the rachis with papillate hairs, bracts absent. Fruiting pedicels are divaricate to horizontal, slightly recurved (or rarely straight), ± flattened, 2–3.5 (–5) × 0.2–0.3 mm, puberulent. Sepals 4, tardily deciduous to somewhat persistent, 0.7–1.0 × 0.4–0.6 mm, ovate or broadly oblong. Petals absent or present, white, 0.1–0.7 × 0.05–0.15 mm. Stamens 2. Styles up to 0.1 mm long, anthers 0.15–0.2 mm. Fruits are silicles, broadly obovate to elliptic, 2.2–3.5 × 2–3 mm, nearly circular, widest at the middle, the tip shallowly notched and relatively narrowly winged, flattened, glabrous or sparsely puberulent along margin. Seeds 1.2–1.6 × 0.7–1.0 mm, ovate, not winged, the surface with a minute, netlike pattern, brown. Flowering between March and August, var. *insulare* from October to March (Hitchcock 1945, Al-Shehbaz and Gaskin 2010).

Results

In Hungary, a small stand of *L. oblongum* was found by the first author in 2018 next to the railway station of Jánosháza (Kisalföld, NW-Hungary) on a railway loading bay. Species-level identification was made in 2020, and was confirmed by Ihsan A. Al-Shehbaz, American Brassicaceae-specialist, based on photographs. Subsequently, we investigated further possible occurrences of *L. oblongum*. As a result, the plant was found in the vicinity of 10 settlements, all next to railway tracks (Fig. 2, Appendix).

Tab. 1. Main differences between *Lepidium oblongum* and three similar species native to or naturalized in Europe (*L. ruderale*, *L. densiflorum*, *L. virginicum*) based on our own measurements.

Feature	*L. ruderale*	*L. oblongum*	*L. densiflorum*	*L. virginicum*
Flowering time	from early May to early autumn	from early April to June (sometimes also in autumn)	from mid May to August	from mid May to August
Stem height (cm)	(2–)5–20(–30)	5–15(–18)	15–60	30–45
Growing form	obliquely/straight ascending	obliquely ascending or decumbent	straight ascending	straight ascending
Inflorescence shape	wide-ovate	wide-ovate	elongated-ovate or elliptical	elongated-ovate or elliptical
Branching shape of the shoot system	decumbently branched from the lower or middle third	extensively, decumbently branched from the lower third	few lateral branches above the lower third, rarely unbranched	few lateral branches above the lower third
Colour of the leaves and the stem	dark grayish-green	dark grayish-green	bright green	bright green
Odor of the plant	unpleasant odor	odorless	odorless	odorless
Length of unit Inflorescence (cm)	(3–)5–8(–10)	3–10	(7–)10–16	5–9
Length of fruits with Peduncles (mm)	3–3.5	2.5–3	3–3.5	4–5
Division and shape of blade on cauline leaf	individed, fibrosus	divided (lobed) spear-elliptical	individed, speared	individed, speared
Margin of cauline leaf	intact (lower ones sliced)	rotund, lobed-dentated	roughly dentated, upper ones intact	roughly dentated (included upper ones)
Cauline leaf length/width ratio	10–12	2.5–4	25–30	3–3.5

In Hungary, we observed its occurrences within the wider environment of railway stations. The most common appearances of the species are railway loading areas (NW Hungary: Jánosháza), the railway interchanges on the edges of the stations (NW Hungary: Csorna; W Hungary: Szombathely; SW Hungary: Gyékényes), as well as the surroundings of railway guard houses (NW Hungary: Győr, Pápa), reversing and loading tracks (W Hungary: Szombathely; NW Hungary: Hegyeshalom; SW Hungary: Murakeresztúr), and level crossings (NW Hungary: Csorna, Pápa; W Hungary: Szombathely).

The size, appearance and colour of *Lepidium oblongum* makes it similar to *L. ruderale*, a member of the European section of the genus Dileptium DC. However, in North America, it is most similar to *L. bipinnatifidum* Desv. and *L. auriculatum* Regel et Körn. (Hitchcock 1945). It differs from *L. ruderale* in having even cauline leaves moderately to deeply divided (vs. entire or toothed), the sepals more or less persistent at fruiting (vs. shed early), and in its tendency toward broadly obovate to circular fruits (vs. fruits elliptic). Additionally, it can be distinguished by the branching type of the shoot system and the odorlessness of the plant (see Tab. 1, Fig. 3). In heavily trampled habitats, low, there are decumbent dwarf specimens of *L. ruderale* branching above the ground with the appearance similar to *L. oblongum*. The latter, however, has thicker and stiffer stems and regardless of restricted conditions develops a strongly branching spreading shoot above the ground. On the rare European alien *L. bonariense* there are pinnately lobed leaves with narrow leaflets. Distinctive features of *L. oblongum* and three similar *Lepidium* species are summarized in Tab. 1.

Discussion

Lepidium oblongum is clearly distinguishable from all other annual *Lepidium* species in Europe by its divided (dentate-lobed) upper cauline leaves. Macro-morphological characteristics of individuals observed in Hungary are generally the same as seen in Hitchcock (1945) and Al-Shehbaz and Gaskin (2010). However, the slightly longer racemes (3–10 cm in the Hungarian specimen) make a small difference.

As *L. oblongum* was formerly not included in the European *Lepidium* key, we recommend the following addition to the key of De Carvalho e Vasconcellos et al. (1993):

1. Petals shorter than the sepals or absent 2
2. Upper cauline leaves pinnatifid 3

– Upper cauline leaves entire or dentate; stem glabrous, papillose or with scale-like trichomes 4

3. Lobes of upper cauline leaves elongated, linear; stem with long, unbranched hairs . . . . . **11. *bonariense***

– Lobes of upper cauline leaves wide, short; stem with cylindrical hairs . . . . . **12. *oblongum***

In the absence of confirmed data on the conditions of the introduction into Europe, this is obscure, but relatively clear conclusions can be drawn from the habitat of the spe-

Fig. 2. Current distribution of *Lepidium oblongum* in Europe.

cies, which can be considered narrow. Sîrbu and Oprea (2011) found that in Romania the first individuals of *L. oblongum* arrived via the railway line, however, the primary vector of the introduction is unknown.

Observations at various railway buildings and around the railway track prove that its appearance in Hungary is undoubtedly related to railway transport. These areas of the railway track are the track sections most affected by the

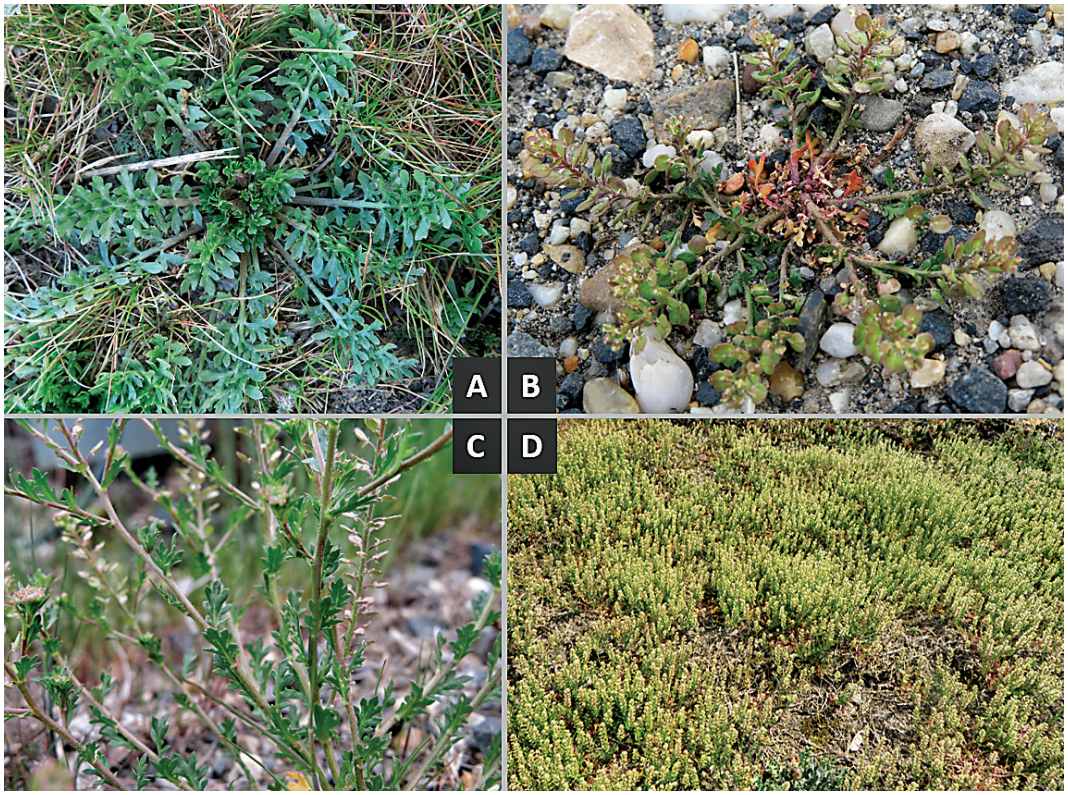

Fig 3. Habitus (A – C) and habitat (D) of *Lepidium oblongum* in Hungary. A – Csorna, March 26th, 2021, B-C – Jánosháza, April 27th 2020, D – Jánosháza, April 23rd, 2020. Photo: D. Schmidt.

movements of railway workers (loading workers, track workers, shift managers). Consequently, the dispersal and spreading of propagules (mature seeds) is affected by (i) the transport route of freight wagons, (ii) the place of unloading of the cargo from the freight wagons, (ii) movement of railway workers.

According to our observations, in all sites the larger, monodominant stands of the plant, covering several square meters appeared in a ribbon-like way, often several hundred meters long on the edge of the footpath trampled by railway workers (e.g., in Szombathely). The introduction by railways is also indicated by the specimens of the plant appearing in Szombathely about 300 meters away from the main railway line, next to a side track used by a large industrial company. The company is one of the leading furniture and construction panel manufacturers in Central and Eastern Europe, transporting its products by rail to various countries in Europe. On the Hungarian – Croatian border Gyékényes railway station also handles significant freight traffic, however no goods are transshipped here. A possible source of introduction here is the shipments of iron ore from America by rail. The Hegyeshalom railway station on the Budapest – Vienna main railway line (operating as a railway border station between Hungary and Austria) also handles significant freight traffic.

According to collection data, the habitats identified in Hungary are very similar to those in Alabama. The species has been collected from roadsides and crushed stone surfaces along railway lines in the last two decades (Keener et al. 2020), where the railroad track was frequently sprayed with herbicide, and there was little else growing there (Alvin Roosevelt Diamond ex litteris). The extreme stress tolerance of the species is well indicated by the fact that we observed its stands on the part of the railway track where multiple stress factors (lack of water, mineral deficiency, contamination, trampling) have major impacts. The severely dry surface and the excessive, surplus heat from the reflected solar radiation further impair the chances of the plants settling. According to our observations, *L. oblongum* is one of the most adaptable species that can colonize trampled and contaminated surfaces, and other vascular plants are often unable to settle in its environment. In this regard, it is similar in position to *Digitaria* spp., *Setaria* spp., *Tragus racemosus* (L.) All. or *Tribulus terrestris* L. (Dancza et al. 2002) which are widespread along railway lines and are able to colonize extremely dry crushed stone surfaces independently as well, but these species as annual C_4 plants avoid *L. oblongum* in time. Due to the recent introduction of the species, phytosociological characterization would be premature, but it can be stated that for the time being *L. oblongum* appears mostly in the spring aspect of the ruderal *Digitario sanguinalis-Eragrostietum minoris* Tüxen ex von Rochow 1951 in Hungary (Lososová 2009). It is notable that on occasion the species successfully survives the regular chemical weed control carried out by the Hungarian railway companies (e.g. in Csorna, Pécs). In Hungary another reason for the unsuccessful weed control of the species is that in the period between sprayings twice a year (spring and late summer) the plant is able to successfully sprout, but the unevenness of the chemical application also contributes. Certain stems fall outside the sprayed sections of the railways (e.g. in W Hungary: Szombathely and Jánosháza; SW Hungary: Pécs).

Its high tolerance to drought and high temperatures is evidenced by the fact that it is common in such habitats in the native area. According to Al-Shehbaz (1986), it is most common in the semi-arid, arid, and hot desert climate zones in the United States and Mexico. In these areas, the annual rainfall is between 150 and 300 mm, but in some cases it is less than 100 mm. Based on available herbarium data in the United States (Swbiodiversity 2021), newer appearances are gradually approaching areas with cooler climates ($T_{avg} \leq 15$ °C). In the last two decades, it has reached the southern boundary of the humid continental belt to the north (Ohio, Missouri). In Europe, the species also appeared in the humid continental climate zone, however, the sites in Hungary and Romania are significantly drier than in Ohio (Tab 2.).

In addition to the macroclimate, railway embankments are sun-exposed stony man-made habitats, which offer drier and warmer conditions than the prevailing macroclimate (Jasprica et al. 2017). Collecting sites of *L. oblongum* in Hungary are mostly urban railway stations with extra heat surplus, with the exception of the location in Jánosháza, which is not affected by the urban heat island. Nevertheless, the very poor water retention capacity of the material of the railway embankment plays an important role in the success of the spread of the species, as does the excess heat. In particular, precipitation in late winter and early spring period from germination to flowering are crucial. As a semi-desert species, it tolerates the lack of rainfall during these months.

Based on its evolutionarily determined stress tolerance limits, further rapid spread in Europe is not hindered from a climatological point of view. Its ability to adapt rapidly is confirmed by Sîrbu and Oprea (2011), who found that the germination of samples taken from Romanian populations was 83 %.

Distribution intensity is greatly increased by the fact that abundant stands in Hungary are located next to the railway lines that handle international transport. Railways have provided access to invading *L. oblongum* through their continuity and relatively high-resource availabilities.

Conclusion

In conclusion, a species of American origin has arrived in Europe, that, thanks to its climatic demands, high stress tolerance and dispersal strategy, is capable of explosive spreading in a matter of years. Due to herbicide resistance we have to reckon with it as a locally invasive weed species along Hungary's railway lines. From a climatological point of view the whole of Europe offers a potential habitat for the species.

Tab. 2. Comparative table of climatological indicators for some American and European sites of *Lepidium oblongum*. Abbreviations: T_avg – Average yearly temperature (period 1991–2020), Tmonth_min – Lowest monthly minimum temperature (period 1991–2020), R_annual – Annual precipitation (period 1991–2020), R_1–4 – Four-month precipitation from January to April (1991–2020).

Continent	Country	County	Locality	Status	Geographical latitude (N)	Elevation (m)	T_avg (°C)	Tmonth_min (°C)	R_annual (mm)	R_1-4 (mm)
America	Mexico	Puebla	Puebla	native	19°02’	2135	17.2	4.9	969	58.7
America	Mexico	Zacatecas	Zacatecas	native	22°46’	2440	15.7	4.7	495	52.2
America	Mexico	Chihuahua	Chihuahua City	native	28°38’	1415	18.6	2.0	386	34.2
America	Mexico	Sonora	Hermosillo	native	29°05’	200	25.1	10.2	387	44.1
America	Mexico	Baja California	Ensenada	native	31°51’	16	17.2	7.5	258	171.8
America	Mexico	Baja California	Mexicali	native	32°39’	8	23.1	5.7	71	25.2
America	USA	California	Anacapa	native	34°09’	11	15.9	11	302	356
America	USA	Arizona	Tucson	native	32°13’	728	20.8	-2.8	294	72.9
America	USA	New Mexico	Albuquerque	native	35°06’	1619	14.0	-11.1	240	50.7
America	USA	Texas	Hereford	native	34°49’	1163	13.6	-6.1	475	77
America	USA	Oklahoma	Oklahoma City	native	35°28’	366	16.3	-2.0	912	231
America	USA	Arkansas	Little Rock	native	34°44’	102	17.0	-0.4	1264	433
America	USA	Lousiana	Monroe	native	32°30’	22	18.7	2.0	1372	479
America	USA	Kansas	Wichita	native	37°41’	397	13.9	-5.6	829	185
America	USA	Missouri	Albany	native	40°14’	279	11.3	-9.7	910	198
America	USA	Kauai (Hawaii)	Lihue	alien, naturalized	21°58’	67	24.3	18.6	941	349
America	USA	Alabama	Montgomery	alien, naturalized	32°21’	73	18.4	2.1	1348	505
America	USA	Tennessee	Nashville	alien, naturalized	36°10’	182	15.2	-2.0	1200	401
America	USA	Maryland	Centreville	alien, casual	39°02’	15	13.1	-4.3	1053	323
America	USA	Kentucky	Louisville	alien, naturalized	38°15’	142	14.5	-2.9	1141	371
America	USA	Ohio	Cleveland	alien, casual	41°28’	199	10.8	-5.7	994	291
America	USA	Washington	Seattle	alien, naturalized	47°36’	53	12.0	2.0	952	393
Europe	Romania	Buzău	Râmnicu Sărat	alien, naturalized	45°37’	95	11.3	-4.4	502	106
Europe	Hungary	Győr-Moson-Sopron	Győr	alien, naturalized	47°41’	108	10.2	-3.3	532	131
Europe	Hungary	Vas	Szombathely	alien, naturalized	47°13’	209	9.5	-4.8	611	129
Europe	Hungary	Baranya	Pécs	alien, naturalized	46°03’	153	10.4	-4.0	619	164

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Appendix

Collecting localities: Western-Transdanubia, Jánosháza railway station, on loading platforms and along railroads, thousands of individuals; Lat.: 49°45'50" N, Long.: 28°52'28" E, alt.: 295 m, leg. & det. D. Schmidt, 28.04.2018 (CEU: 8869.3); Western-Transdanubia, Szombathely, goods station between Zanati street and Szent Gellért street, stands of varying sizes in length at least 750 meters on the territory of goods station, at the edge lines; Lat.: 47°13'43.15" N, Long.: 16°38'15.59" E, alt.: 211 m, leg. & det. D. Schmidt, 08.06.2020 (CEU: 8765.4); Western-Transdanubia, Szombathely, industrial railway line between Pálya street and Sági street, two small stands (50–100 specimen) directly along the rail; Lat.: 47°14'00.27" N, Long.: 16°38'24.94" E, alt.: 210 m, leg. & det. D. Schmidt, 22.06.2020 (CEU: 8765.4); Small Hungarian Plain, Pápa, opposite to the railway guard house next to Külső-Győri street, a bigger and a smaller stand; Lat.: 47°20'37.16" N, Long.: 17°27'52.75" E, alt.: 140 m, leg. & det. D. Schmidt, 13.06.2020 (CEU: 8670.4); Small Hungarian Plain, Csorna, west of the railway station, next to the Bartók street junction, rich population; Lat.: 47°36'00.80" N, Long.: 17°14'37.03" E, alt.: 117 m, leg. & det. D. Schmidt, 19.06.2020 (CEU: 8369.3); Small Hungarian Plain, Győr, between goods station and the main railway station, along the outermost trail, a couple of individuals; Lat.: 47°41'04" N, Long.: 17°38'32" E, alt.: 113 m, leg. & det. D. Schmidt, 19.06.2020 (CEU: 8371.2); Great Hungarian Plain, Budapest, Budapest Keleti railway station, scattered between 32nd and 33rd storage track, Lat.: 47°29'59.8" N, Long.: 19°05'19.1" E, alt.: 110 m, leg. P. Gnotek, det. D. Schmidt, 21.06.2020 (CEU: 8480.4); South-Transdanubia, Pécs, main railway station, near by and along the train washing bay, Lat.: 46°03'56.01" N, Long.: 18°13'05.66" E, alt.: 121 m, leg. & det. J. Csiky, 16.05.2020 (CEU: 9975.1); Western-Transdanubia, Gyékényes, scattered at railway station; Lat.: 46°14'56.90" N, Long.: 16°57'14.80" E, alt.: 131 m, leg. & det. A. Mesterházy, 02.06.2020 (CEU: 9767.4); Small Hungarian Plain, Hegyeshalom, common in railway station near industrial railway; Lat.: 47°54'59.51" N, Long.: 17°08'24.27" E, alt.. 126 m, leg. & det. A. Mesterházy, 09.06.2020 (CEU: 8068.4); Western-Transdanubia, Murakeresztúr, small population near industrial railway at railway station; Lat: 46°21'50.15" N, Long.: 16°52'31.35" E, alt.: 136 m, leg. & det. A. Mesterházy, 02.06.2020 (CEU: 9667.1).