

***Geranium purpureum* Vill. – new alien species to the Slovak flora**

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Abstract: *Geranium purpureum* WILL. (Little Robin), a new alien species of Slovak flora was found for the first time at railway stop of the Gáň village in July 2010. This finding started research at other railway stations in south-west Slovakia and other seventeen localities were found (Kúty, Bratislava, Sereď, Galanta, Šafa, Trnovec nad Váhom, Komjatice, Tvrdošovce, Hurbanovo, Nové Zámky, Komárno, Mužla, Kalná nad Hronom, Tekovské Lužany, Levice, Bíňa, Štúrovo). Our results showed that *G. purpureum* is now relatively common alien species of railway habitats in southwestern Slovakia. The species has occupied especially free gravel sites in railway tracks and its close surroundings in open ruderal pioneer community. It disappears from closed vegetation. A brief description of the species is given and its distribution in Slovakia and Central Europe is mentioned.

Keywords: *Geranium purpureum*, alien species, railway, ecology, Slovakia.

Introduction

From urban environments, plant communities dominated by alien species were mainly reported from railway areas and from heavily disturbed urban-industrial areas (KOWARIK 2008). These species have no special preferences for local habitat conditions and their highest proportion was found mainly in disturbed habitats at low elevations (CHYTRÝ et al. 2005).

Geranium purpureum VILL. [Little Robin, syn. *G. robertianum* subsp. *purpureum* (VILL.) NYMAN] is a relatively new alien species in the Central Europe,

it was found here only twenty years ago (MELZER 1990, HÜGIN et al. 1995). The species is native from northern Africa, north-western, south-western and south-eastern Europe to Western Asia and Caucasus, as alien species was found in north-western and central Europe, North and South America, Australia and New Zealand (HRUSA et al. 2002, TOFTS 2004). *G. purpureum* is a native plant of hedge banks, walls, cliffs, shingle, railway ballast, grassland and disturbed habitats (BAKER 1955, WEBB & FERGUSON 1968).

The species is after TOFTS (2004) a leafy annual (occasionally also reported as biennial), 10–35 cm high, usually branched from the base, bright or dark green, sometimes slightly reddish-tinged, fragile, with a strong disagreeable smell. Stems decumbent or ascending, ± clothed with dense hairs below, often nearly glabrous above but very variable in the indumentum. Leaves are palmate, bright green, lower mostly with five leaflets, often narrow, with scattered adpressed hairs on both sides, on long petioles. One to five extended internodes produced on the main axis with the first flowering branches arising at the upper nodes of this portion and the later ones arising from the lower nodes of the extended stem and upper nodes of the rosette. Pedicels 2–27 mm long, ascending after flowering, mostly straight, pilose. Flowers in pairs (a cymule), sepals five, ovate, mucronate or shortly aristate, ± pilose and glandular, erect and somewhat connivent, near apex, without ridges, calyx not angled, petals five, 5–9.5 mm long (including claw), lamina 2.5–3.5 × 1.5–2.5 mm, purplish-pink. Undehisced anthers yellow, pollen yellow. Mericarps 2.3–3 mm, reticulately ridged, usually with 3–5 pronounced overlapping collars at apex. Seeds are ovoid, smooth, brown, ca 2.0 × 1.2 mm long.

Two subspecies were described (BAKER 1955, 1957, PRATT 2004) although they are not accepted by some authorities (e. g. WEBB & FERGUSON 1968, PIGNATTI 1982). Nominative subsp. *purpureum* has erected to ascending growth form. *G. purpureum* subsp. *forsteri* (WILL.) H. G. BAKER is prostrate, tips of shoots are ascending.

The aim of this study was to present current distribution of this new alien species to Slovak flora and analyse ecological requirements of it in Slovakia.

Material and Methods

The phytosociological relevés was sampled according to the Zürich-Montpellier approach using the adapted Braun-Blanquet's scale (BARKMAN et al. 1964). The nomenclature of all taxa except *G. purpureum* are in accordance with MARHOLD & HINDÁK (1998); while nomenclature of *G. purpureum* follows AEDO et al. (1998). Herbarium vouchers collected by the author are stored in herbarium NI. The herbarium abbreviations used follow HOLMGREN et al. (1990).

Result of this study is presented on the point map. Coordinates of recent localities were obtained during field research using GPS equipment Garmin CS 60; the numbers of grid squares follow one that was described by NIKLFELD (1971).

Results and discussion

In June 2010, several tens *Geranium purpureum* plants (Fig. 1) were found at the railway stop in the Gáň village. Occurrence of this species has not been previously reported from Slovakia (see JASIČOVÁ 1988, DOSTÁL & ČERVENKA 1991, Letz 1996, MARHOLD & HINDÁK 1998). After the discovery of the first location in Gáň, the author also examined other stations in south-western Slovakia and the occurrence of *G. purpureum* was recorded at fifteen other sites (Sereď, Galanta, Šafa, Trnovec nad Váhom, Komjatice, Tvrdošovce, Nové Zámky, Hurbanovo, Komárno, Mužla, Levice, Kalná nad Hronom, Tekovské Lužany, Bíňa and Štúrovo). Last, the westernmost localities of the species were discovered by P. ELIÁŠ sen. on gravel deposits of the Bratislava – Nivy train station (ELIÁŠ sen. 2010 ined.) as well as I. JAROLÍMEK and M. PETRÁŠOVÁ found it also in Kúty railway station (PODROUŽKOVÁ-MEDVECKÁ et al. 2011). Overall, *G. purpureum* was currently found at 18 railway stations and stops (Fig. 2). Our results showed that the species is now relatively common alien of railway habitats in southwestern Slovakia.



Fig. 1. Herbarium specimen of *Geranium purpureum* Vill. from the Gáň train stop (SW Slovakia).

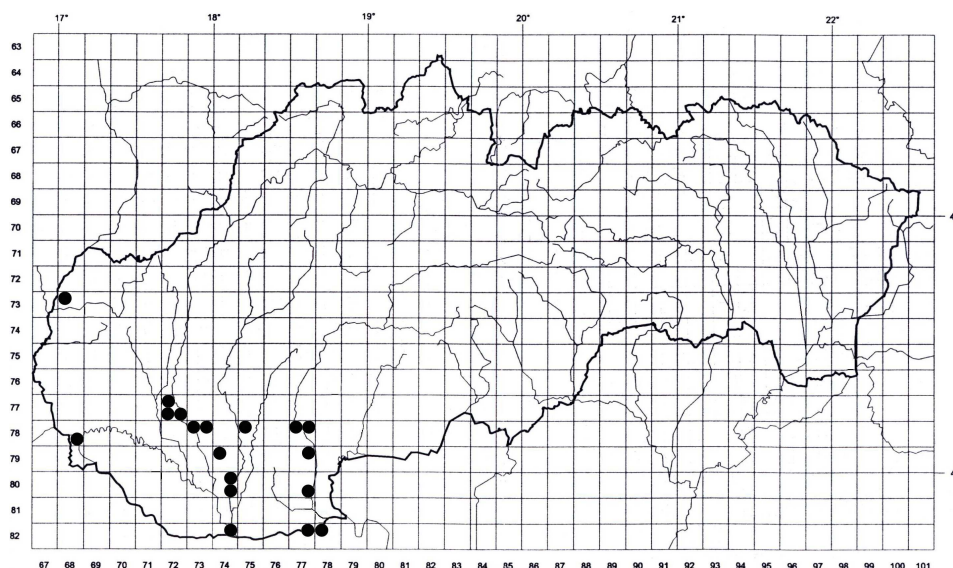


Fig. 2. Current distribution of *Geranium purpureum* Vill. in Slovakia.

Appearance of *G. purpureum* in Slovakia is not surprising, because the species had been already recorded in three neighbouring countries as alien. It was first detected in south-eastern Austria at the beginning of nineties of last century (MELZER 1990). A little later, in 2005, *G. purpureum* was found in southern Moravia (RŮŽIČKA & KOBLÍŽEK 2009) and in Balatonmárfürdő Alsó and Murakersztúr in north-western Hungary (MESTERHÁZY 2005). Recently, the species was recorded in many other locations in these countries (WALTER 1998, RŮŽIČKA & KOBLÍŽEK 2009, MESTERHÁZY & KIRÁLY 2010). However, the species is massive spreading also in western Europe since nineteen's of last century, it was recorded in Netherlands (van der MEIJDEN & HOLVERDA 1991), Switzerland (HUBER 1992), Germany (HÜGIN et al. 1995), northern France (BOULET 1997), and Belgium (DUVIONEAUD & SAINTENOY-SIMON 1998, VERLOOVE 2000). In light of these data, we believe that *G. purpureum* was introduced to Slovakia minimally 5-10 years ago, but it was overlooked and / or considered similar taxon *G. robertianum*. However, here is an obvious difference in size of flowers at first sight (Fig. 3) as well as in the other characteristics mentioned in Tab. 1.

Tab. 1. The main differences between *Geranium purpureum* Vill. and *G. robertianum*.

	<i>Geranium purpureum</i>	<i>Geranium robertianum</i>
Number of chromosomes	32	64
Hairs on the calyx	±0,5 mm	0,5-2 mm
Length of corolla	5-9 mm	10-13 mm
Anthers colour	yellow	pink, orange, purple or red
Fruits	apex with 3-5 pronounced overlapping ridges	apex with 1-2(-3) overlapping weak ridges

Tab. 2. Vegetation with dominance of *Geranium purpureum* sampled on some locations in southwestern Slovakia in 2010.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Relevé surface (m ²)	10	30	20	15	20	10	35	25	50	25	25	10	15	30	15
Coverage E ₁ %	10	10	15	15	30	10	15	10	10	10	15	20	10	20	2
Number of species per relevé	6	11	13	9	18	7	10	12	9	8	15	15	11	17	5
<i>Geranium purpureum</i>	1	1	1	1	+	1	+	1	1	1	a	a	1	1	+
<i>Galium aparine</i>	+	1	1	1	1	.	1	+	1	+	+	1	+	.	.
<i>Bromus tectorum</i>	+	+	+	+	a	+	1	.	.	.	1	a	+	1	.
<i>Arenaria serpyllifolia</i>	1	+	+	.	+	+	.	.	+	1	+	+	+	+	.
<i>Lactuca serriola</i>	.	r	.	.	+	+	r	+	r	+	.	+	+	+	r
<i>Fallopia convolvulus</i>	.	+	.	+	+	.	+	1	.	+	.	+	.	.	r
<i>Papaver rhoeas</i>	+	r	+	.	+	.	+	+	.	.	+	.	+	1	.
<i>Viola arvensis</i>	.	+	+	.	+	.	+	.	.	+	+	+	+	1	.
<i>Brassica napus</i>	.	.	.	.	.	1	+	+	.	.	+	.	+	.	.
<i>Bromus sterilis</i>	.	.	r	+	.	.	.	.	.	.	+	+	.	+	+
<i>Crepis foetida</i>	.	.	.	.	.	.	.	.	.	.	1	+	+	+	.
<i>Medicago lupulina</i>	.	+	.	.	+	.	.	.	.	.	.	1	.	+	.
<i>Conyza canadensis</i>	.	.	r	.	r	.	.	.	.	.	+	+	.	.	.
<i>Senecio vernalis</i>	+	r	+	.	.	.	.	.	.	.	+	.	.	.	.
<i>Arrhenatherum elatius</i>	.	.	r	.	.	.	.	r	r	.	.	.	r	.	.
<i>Veronica arvensis</i>	.	.	+	.	+	.	.	.	.	.	.	.	.	+	.
<i>Triticum aestivum</i>	.	.	.	.	.	+	r	+	.	.	.	.	.	.	.

Species recorded in one relevé only: *Apera spica-venti* r (10); *Avena fatua* + (8); *Cerastium* sp. + (14); *Convolvulus arvensis* + (8); *Digitaria sanguinalis* 1 (5); *Equisetum ramossissimum* 1 (3); *Holosteum umbellatum* r (9); *Hordeum murinum* r (11); *Hordeum vulgare* r (12); *Lamium amplexicaule* r (9); *Medicago sativa* r (14); *Potentilla argentea* agg. r (14); *Portulaca oleracea* r (5); *Lolium perenne* r (11); *Plantago lanceolata* r (14); *Prunus domestica* juv. r (8); *Sambucus ebulus* r (13); *Sonchus arvensis* r (4); *S. asper* r (8); *Taraxacum* Sect. *Ruderalia* r (2); *Thlaspi arvense* r (4); *Trifolium repens* r (14); *Veronica persica* + (5).

Species recorded in two relevés only: *Ambrosia artemisiifolia* r (5), r (6); *Capsella bursa-pastoris* + (5), r (12); *Crepis setosa* + (8), + (9); *Digitaria sanguinalis* 1 (5); *Galium spurium* + (3), + (4); *Torilis japonica* + (5), r (11); *Tragopogon dubius* r (5), r (9); *T. orientalis* r (7), + (14); *Tripleurospermum perforatum* + (12), + (14).

List of relevés locations (for relevés, the header data are listed in the following order: number of relevé, locality, coordinates, altitude, sampling date):

1. Gáň, rough gravel in the railway tracks in railway stop (48° 08' 30"N; 17° 05' 28"E), 120 m s. l., June 8, 2010.
- 2., 3. Sered', rough gravel in the railway station north from the station building (48° 08' 30"N; 17° 05' 28"E), 125 m s. l., June 23, 2010.
- 4., 5. Galanta, railway station, gravel in stabling tracks (), 117 m s. l., June 23, 2010.
6. – 8. Šaľa, railway station, free gravel in main tracks (), 112 m s. l., June 23, 2010.
- 9., 10. Trnovec nad Váhom, railway station, gravel in stabling tracks (), 112 m s. l., June 23, 2010.
11. – 13. Nové Zámky, railway station, gravel in stabling tracks (), 116 m s. l., June 25, 2010.
14. Komárno, railway station, gravel in main tracks (), 111 m s. l., June 25, 2010.
15. Levice, railway station, newly dropped gravel in main tracks (), 125 m s. l., June 27, 2010

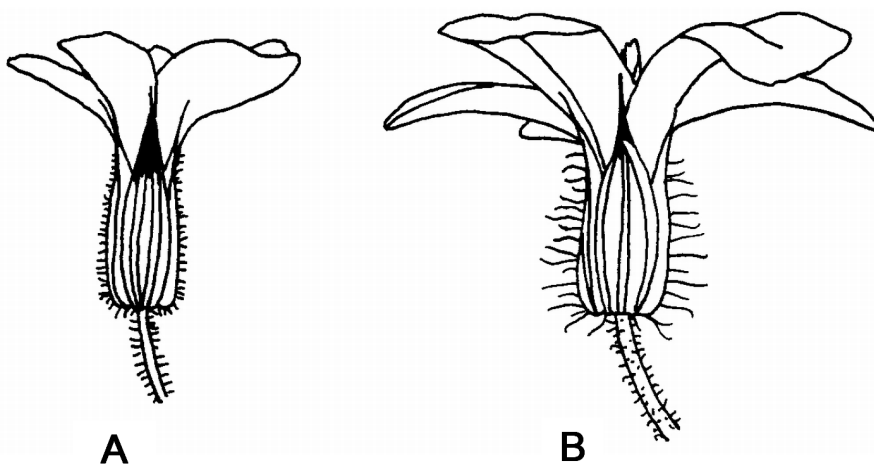


Fig. 3. Comparison of flower size of *Geranium purpureum* Vill. (A) and *G. robertianum* L. (B) (after Yeo, 1973).

In Slovakia, the species was usually dominant in open ruderal plant community on broken stone ballast in railway trackages and often accompanied by species such as *Galium aparine*, *Bromus tectorum*, *Arenaria serpyllifolia*, *Lactuca serriola*, *Fallopia convolvulus*, *Papaver rhoeas*, and *Viola arvensis* (Tab. 2, rels. 1-4, 6-15). If the vegetation was more closed, abundance of *G. purpureum* decreased strongly (Tab. 2, rel. 5). We have also observed that the species was found exclusively on relatively newly dropped gravel, which supports the data of RŮŽIČKA & KOBLÍŽEK (2005). The authors mentioned that its occurrence was obviously connected to the total reconstruction of the railway corridors. An example of this initial stage of *Geranium purpureum* vegetation we recorded on renewed embankment in the Levice train station (Tab. 2, rel. 15).

Little robin is probably not strictly subjected to a particular type of vegetation, although POLDINI (1989) reported it from *Asplenietum trichomano-rutae-murariae* subassociation *calaminthetosum* (alliance *Potentillion caulescentis*) as a differential species. However, the author reported it also from other different associations: *Micromerio-Euphorbietum wulfenii* (alliance *Centaureo-Campanulion*), *Alyssu alyssoidis-Sedetum albi* and *Frangulo rupestris-Prunetum mahaleb* (alliance *Berberidion*). MATEVSKI & ČARNI (2001) reported the species from thermophylic community *Veronica cymbalaria-Cardamine graeca* developed under *Platanus* trees in the southern part of Macedonia and in the northern part of Greece. Finally, FANELLI (2002) found *G. purpureum* in ruderal communities of the class *Stellarietea mediae*.

An occurrence of the species in Slovakia as well as in other countries of west and central Europe is undoubtedly connected with railway traffic (see HÜGIN et al. 1995, BÖNSEL et al. 2000, PLAZAR & JOGAN 2001, TOFTS 2004). Although *G. purpureum* spreading is restricted due sympatric effect of intense herbivory and

relatively inefficient seed dispersal mechanism in natural conditions (HERRERA 1991), fast spreading was recorded in the secondary distribution range by agestochory (HÜGIN et al. 1995, RŮŽIČKA & KOBLÍŽEK 2009, MESTERHÁZY & KIRÁLY 2010). In accordance with BÖNSEL et al. (2000), this Mediterranean native is resistant to herbicides and it has the potential to spread quickly and across large distances, because *G. purpureum* fruits have propensity for to adhere, even to glass panes. It is thus clear that the number of *G. purpureum* locations will certainly increase in the Western and Central Europe and the species may be problematic for environment in the short term.

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