

# GENUS *Sisymbrium* L. (ROCKETS) IN THE FLORA OF LATVIA

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*One of the largest genera in the Cruciferae family in Latvia is Sisymbrium L. The genus includes not only native, but also some alien species. The distributions of the Sisymbrium species were reviewed for the first time in the last 50<sup>th</sup> years in Latvia. The distribution data were compiled from herbarium material, literature and field surveys. An identification key for the Sisymbrium species in Latvia and detailed scientific nomenclature are presented in the current study. In total, seven species of Sisymbrium were found in Latvia — S. supinum L., S. loeselii L., S. polymorphum (Murray) Roth, S. volgense M. Bieb. ex E. Fourn., S. altissimum L., S. orientale L. and S. officinale (L.) Scop. The mainly were recorded in railway verges, roadsides, waste dumps and wasteland. Five species of the genus are alien to the flora of Latvia — S. loeselii, S. altissimum, S. polymorphum, S. orientale, and S. volgense; two are native — S. supinum and S. officinale.*

**Key words:** vascular plants, taxonomy, morphology, distribution, alien species.

## INTRODUCTION

The Cruciferae Juss. family is widespread in the world and comprises about 390 genera and 3000 species. Cruciferae species mostly occur in the northern hemisphere from the meridionale to the boreale zone, and are most common in Mediterranean region. *Sisymbrium* L. is a large and heterogeneous genus and comprises about 94 species (Warwick *et al.*, 2002), spread over the northern hemisphere from the meridionale to the boreale zone, also in southern parts of Africa and South America. Most of the species found in Central Europe are common in ruderal places close to inhabited areas, others like *S. supinum* L. occur in natural habitats, such as near river banks (Hegi, 1986).

Cruciferae is one of the largest families in Latvia and is represented by 47 genera. A large part of the species of the Cruciferae family in Latvia are alien species. Alien plants are those whose presence in a given area is due to intentional or unintentional human involvement, or which have arrived there without the help of people from an area in which they are alien (Pyšek *et al.*, 2004). Distributions of alien species are affected by the types of entry to the territory and their preferred habitats. The *Sisymbrium* genus includes alien species with various distributions.

Data about the *Sisymbrium* genus appeared in Latvia in the second half of the 18th century in the work of natural scientist J. B. Fisher (Fischer, 1778; 1784; 1791). Research on the Latvian flora, including *Sisymbrium*, expanded in the 19th century. New plant species invaded Latvia due to di-

rect human activity like transport networks or indirect human activity. The *Latvijas PSR flora* (Eleksis, 1955) describes three species of *Sisymbrium* and the list of taxa (Gavrilova and Šulcs, 1999) mentions seven species.

The last comprehensive analysis of the genus was done in the 1950s. However, the flora is constantly changing and it is necessary to update information about composition of plant species and the dynamics of their distribution in Latvia.

The aim of the present study was to revise the genus *Sisymbrium* in the flora of Latvia, by determining the range of taxa, diversity of morphological features and distribution patterns. The objectives were to produce an identification key for the species of genus *Sisymbrium* in Latvia, scientific nomenclature and original distribution maps in Latvia. The systematic study was performed according to the principles of preparation of the monograph *Vascular Flora of Latvia* (Šulcs, 2011).

## MATERIALS AND METHODS

Herbarium material was investigated and field studies were performed in order to carry out a systematic study of the genus *Sisymbrium*. Herbarium material from the Laboratory of Botany, the Institute of Biology of University of Latvia (LATV), the Herbarium of the Museum of Botany of University of Latvia (RIG), the Herbarium of Slītere National park (SVR), the Herbarium of the Natural History Museum

of Latvia (LDM), the Herbarium of the Daugavpils University (DAU), the Herbarium of the Latvia University of Agriculture (LLU), as well as private collections of botanists Alfrēds Rasiņš (RAS), Austra Āboliņa (AB) and Kārlis Ādolfs Veinbergs (VEINB), were examined. For species analyses, about 300 herbarium sheets were used. Field studies were based on the route method either selecting typical habitats of species or habitats where species could potentially be found.

Species descriptions were created based on Latvian plant material. Descriptions of species were elaborated with scientific nomenclature, description of habitats, distribution in Latvia and in the world. Distribution maps of geographical distribution in Latvia were compiled. These were prepared using the square method of geographical coordinates, where one square is approximately  $7.6 \times 9.3$  km. The total numbers of squares in Latvia are 1017, of which 822 are completely located and 195 partly located in the territory of Latvia (Табака и др., 1980). Geographical distribution was characterised according to the geographical regions of Latvia — Coastal Lowland, Western Latvia, Central Latvia and Eastern Latvia (Ramans and Zelčs, 1995).

For species distribution, the evaluation scale accepted by Laboratory of Botany Institute of Biology was used: very rare (1–10 findings), rare (11–30), rather rare (31–100), not rare (101–250), rather frequent (251–500), frequent (501–750), very frequent (more than 751) (Fatare, 1992). Localities were marked in two ways on maps: ● — herbarium data, ○ — University of Latvia Institute of Biology lists of species. A question mark before a number of a square indicated that the square could not be accurately determined due to incomplete locality description.

Regarding nomenclature, authors for taxa are named in accordance with R. K. Brummit and C. E. Powell (1992). Authors who are not included in this work are named, written unabridged. Literary sources cited in the original language and abbreviations correspond to the accepted standard (Mill, 1993). For sources not included in this standard, abbreviations were formed using similar principles. The litera-

ture cited are studies in which the taxon was mentioned for the first time in the Latvian flora, as well as *Latvijas PSR flora* (Eleksis, 1955); *Flora USSR* (Басильченко, 1939) and *Flora Europaea* (Ball, 1964).

Morphological characteristics are required in the analysis of genera and species. One of these characteristics is fruit diversity. In the family Cruciferae, fruits are very varied in shape and form. Typical fruit of the genus *Sisymbrium* is a siliqua, which is characterised by valves, surface, median vein and salience, as well as the length and thickness of style in relation to the siliqua. *Sisymbrium* valves are usually 3-veined. Siliqua are cylindrical or conical. The style is not longer than the width of siliqua. In the Cruciferae family, seeds can be located in one or two rows. In genus *Sisymbrium* these are in one row.

## RESULTS

**Species.** Taxonomic analysis of the genus *Sisymbrium* indicated that seven species have been reported for Latvia — *S. supinum* L., *S. loeselii* L., *S. polymorphum* (Murray) Roth, *S. volgense* M. Bieb. ex E. Fourn., *S. altissimum* L., *S. orientale* L., and *S. officinale* (L.) Scop. Morphological characteristics of the *Sisymbrium* species are shown in Table 1.

**Diagnostic features.** Diagnostic features are lower leaves, upper leaves, petals and siliqua. Inflorescence is a raceme. Flowers have sepals and petals, and are actinomorphic. There are four sepals: free, erect or patent, which are glabrous or with sparse hairs. There are four petals: free, yellow, rare white, clawed. Stamens are simple. External nectarial glands are ring-like around short stamens, with internal forming a ring. Ovary contains two carpels. Stigma is bilobed. Style is short or missing. Fruit is a siliqua with curved valves, with a clear median vein. Seeds are small and numerous. Leaves are pinnatifid to pinnatisect, entire, glabrous or with hairs. In Latvia they are annual and perennial herbs, in the world also small shrubs.

Table 1

### A MORPHOLOGICAL DESCRIPTION OF *SISYMBRIUM* SPECIES

	Lower leaves	Upper leaves	Petals	Siliqua
<i>S. supinum</i>	all leaves pinnatisect, lobes oblong linear		white	one in axil, curved
<i>S. officinale</i>	all leaves pinnatisect, terminal lobe large		yellow	conical, erect, appressed to the stem
<i>S. altissimum</i>	pinnatisect, lateral lobes lanceolate	pinnatisect, lateral lobes linear	yellow	outspread, horizontal, long, as thick as pedicel
<i>S. orientale</i>	pinnatifid	entire, oblong to lanceolate	yellow	outspread
<i>S. loeselii</i>	all leaves pinnatifid to pinnatisect		yellow	outspread
<i>S. volgense</i>	pinnatifid to pinnatisect, terminal lobe large, hastate	entire, lanceolate, patent	yellow	appressed to the stem
<i>S. polymorphum</i>	entire, oblong linear to linear, appressed	pinnatisect, terminal lobe large, ovate	yellow	outspread

## Scientific nomenclature, distribution and habitat of the *Sisymbrium* species in Latvia

### 1. *Sisymbrium supinum* L.

*Sisymbrium supinum* L. 1753, Sp. Pl.: 657; P. W. Ball, 1964, Fl. Europ. 1: 264; Pētersone, 1980, in Pētersone un Birkmane, Latv. PSR augu noteic., 2. izd.: 142.

*Braya supina* (L.) W. D. J. Koch, 1837, Syn. Fl. Germ. 1: 50; Gautzsch, 1939, Korrbl. Naturf.-Ver. Riga, 63: 143; Eleksis, 1955, Latv. PSR Fl. 2: 380, in adnot.

Habitat. Lake shore, dolomite outcrop, ditch verge.

Distribution in Latvia. Very rare, at the bank of lake Kaņieris in 1938 (14/21 V. Mühlenbach, RIG), in Lapmežciems 1957 (?13/22 L. Vītolīja, LLU) (Fig. 1). In Latvia reaches eastern border of distribution area.

General distribution. Central Europe, Northwest Europe, temperate zone.

### 2. *Sisymbrium loeselii* L.

*Sisymbrium loeselii* L. 1755, Cent. Pl. 1: 18; J. Fisch. 1791, Vers. Naturg. Livl., 2. Aufl.: 557; Васильч. 1939, Фл. СССР, 8: 44; Eleksis, 1955, Latv. PSR Fl. 2: 370; P. W. Ball, 1964, Fl. Europ. 1: 265.

Habitat. Weed-laden sites, railway verges, waste dumps, roadsides, weed in the gardens.

Distribution in Latvia. Alien species. Not rare, throughout the territory (Fig. 2).

General distribution. Europe, Caucasus, Western Asia, Central Asia, from meridionale zone to temperate zone. Alien species in North America.

### 3. *Sisymbrium polymorphum* (Murray) Roth

*Sisymbrium polymorphum* (Murray) Roth, 1830, Man. Bot. 2: 946; Васильч. 1939, Фл. СССР, 8: 46; P. W. Ball, 1964, Fl. Europ. 1: 265; Фагаре, 1988, в Табака и др. Фл. сосуд. раст. Латв. ССР: 61.

*Brassica polymorpha* Murray, 1776, Novi Comment. Gotting. 7: 35.

*Sisymbrium junceum* (Willd.) M. Bieb. 1808, Fl. Taur.-Cauc. 2: 114; Kuusk, Rasiņš, Jankevičienė, 1993, Fl. Balt. Countr. 1: 303.

Habitat. Railway tracks, railway embankments.

Distribution in Latvia. Alien species. Very rare, only one locality in Rīga, station Šķirotava recorded in 1936 and 1937 (15/27, V. Mühlenbach, RIG) (Fig. 3).

General distribution. Eastern Europe, Southeastern Europe, Caucasus, Western Asia, Central Asia, Mongolia, submeridionale to temperate zone.

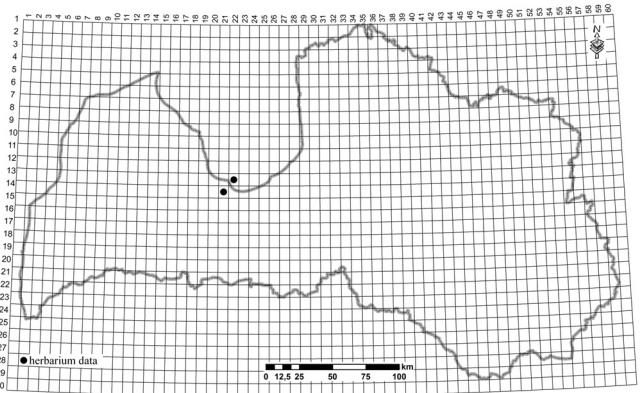


Fig. 1. Distribution of *Sisymbrium supinum* in Latvia.

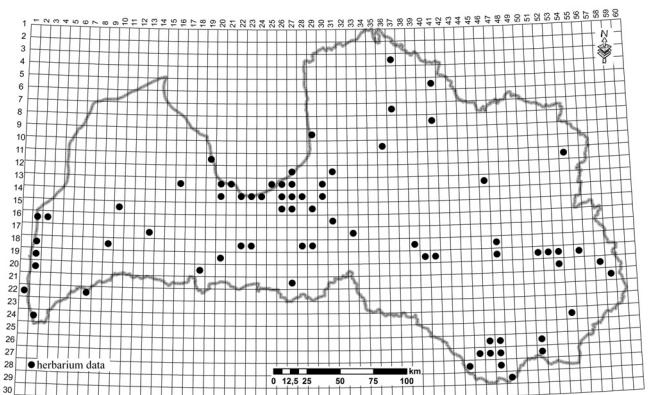


Fig. 2. Distribution of *Sisymbrium loeselii* in Latvia.

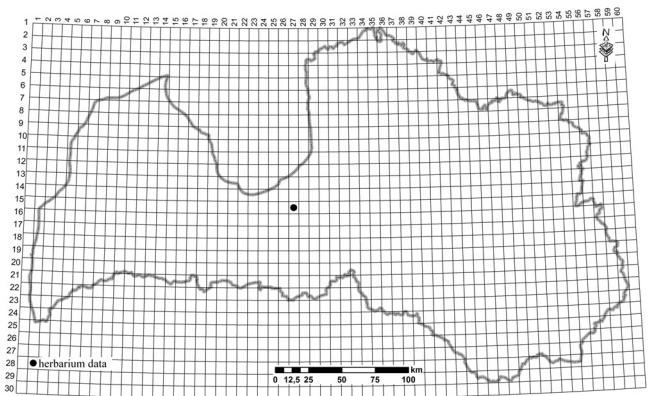


Fig. 3. Distribution of *Sisymbrium polymorphum* in Latvia.

### 4. *Sisymbrium volgense* M. Bieb. ex E. Fourn.

*Sisymbrium volgense* M. Bieb. ex E. Fourn. 1865, Rech. Fam. Crucif.: 97; E. Lehm. 1896, Nachtr. Poln.-Livl.: 86; Васильч. 1939, Фл. СССР, 8: 47; Eleksis, 1955, Latv. PSR Fl. 2: 380, in adnot.; P.W. Ball, 1964, Fl. Europ. 1: 265.

Habitat. Railway verges, roadsides, weed-laden sites.

Distribution in Latvia. Alien species. Rather rare, throughout the territory (Fig. 4). In Latvia northwest from distribution area.

General distribution. Eastern Europe, Western Asia, submeridionale zone.

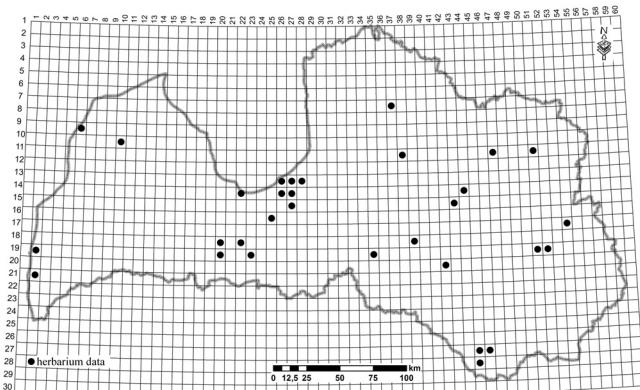


Fig. 4. Distribution of *Sisymbrium volgense* in Latvia.

##### 5. *Sisymbrium altissimum* L.

*Sisymbrium altissimum* L. 1753, Sp. Pl.: 659; Mühlenbach, 1934, Acta Horti Bot. Univ. Latv. 7: 112; Васильч. 1939, Фл. СССР, 8: 49; Eleksis, 1955, Latv. PSR Fl. 2: 371; P. W. Ball, 1964, Fl. Europ. 1: 265.

*S. sinapistrum* Crantz, 1769, Class. Crucif.: 138; Klinge, 1882, Fl. Est. Liv. Curl.: 396.

Habitat. Railway verges, roadsides, fallows, weed-laden sites.

Distribution in Latvia. Alien species. Not rare, throughout the territory (Fig. 5).

General distribution. Europe, except Southwestern Europe, Caucasus, Western Asia, from meridionale to boreale zone. Alien species in North America and South America.

##### 6. *Sisymbrium orientale* L.

*Sisymbrium orientale* L. 1756, Cent. Pl. 2: 24; Mühlenbach, 1934, Acta Horti Bot. Univ. Latv. 7: 112; Васильч. 1939, Фл. СССР, 8: 50; P. W. Ball, 1964, Fl. Europ. 1: 265; Pētersone, 1980, in Pētersone un Birkmane, Latv. PSR augu noteic., 2. izd.: 143.

*S. columnae* Jacq. 1776, Fl. Austr. 4: 12; Rothert, 1915, Korrbl. Naturf.-Ver. Riga, 57: 86.

Habitat. Railway verges, roadsides, weed-laden sites.

Distribution in Latvia. Alien species. Very rare: Rīga (14/26, V. Rothert, 1911, RIG; 14/27, A. Šulcs, 1961, 1962, LDM), Valmiera (7/37, L. Melece, 1976, LATV) (Fig. 6).

General distribution. Central Europe, Eastern Europe (Ukraine), Caucasus, Asia Minor, Central Asia, meridionale and submeridionale zone.

##### 7. *Sisymbrium officinale* (L.) Scop.

*Sisymbrium officinale* (L.) Scop. 1772, Fl. Carn. ed. 2, 2: 26; J. Fleisch. und Em. Lindem. 1839, in J. Fleisch., Fl. Esth. Liv. Kurl: 237; Васильч. 1939, Фл. СССР, 8: 52;

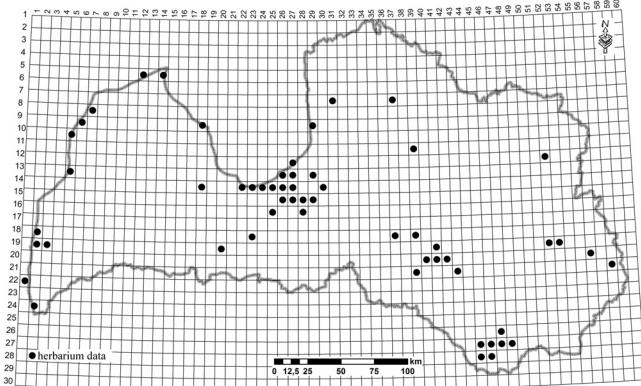


Fig. 5. Distribution of *Sisymbrium altissimum* in Latvia.

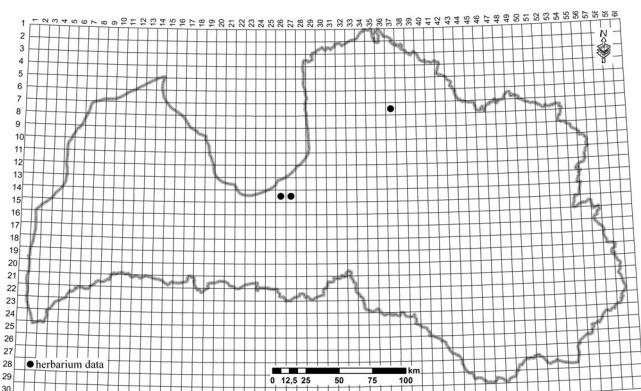


Fig. 6. Distribution of *Sisymbrium orientale* in Latvia.

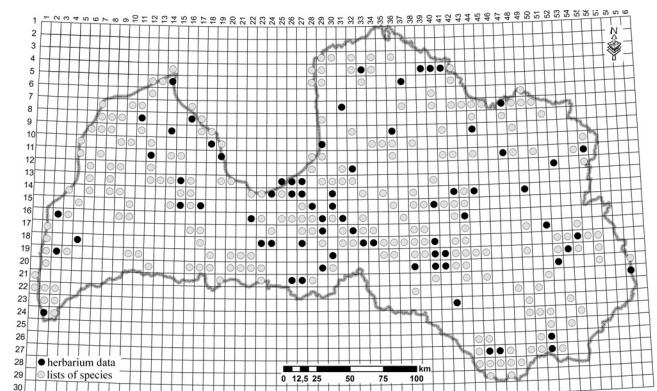


Fig. 7. Distribution of *Sisymbrium officinale* in Latvia.

Eleksis, 1955, Latv. PSR Fl. 2: 372; P. W. Ball, 1964, Fl. Europ. 1: 266.

*Erysimum officinale* L. 1753, Sp. Pl.: 660; J. Fisch. 1778, Vers. Naturg. Livl.: 265.

Habitat. Railway verges, roadsides, waste dumps, weed-laden sites, weed in gardens and fields.

Distribution in Latvia. Frequent, throughout the territory (Fig. 7).

General distribution. Europe, Caucasus, West Asia, North Africa, from meridionale to boreale zone. Alien species in North America.

LATVIAN NAMES OF *SISYMBRIUM* SPECIES

<i>S. supinum</i>	<b>zemā žodzene</b> (Pētersone, 1980)
<i>S. officinale</i>	pērkones, pakūlains (Fleischer, 1830) māju pērkoņi (Arajs, 1902) sētmalu sinepīte, mājas pērkoņi (Bickis, 1920) zāļu slotzāle (Ašmanis, 1923) mājas pērkonī, sētmalu sinepīte (Šķipsna, 1931) slotzāle, ķērnis, zosu zāle, tāle (Punka, 1934) aptieku žodzenes (Galenieks, 1950) ārstniecības žodzenes (Eleksis, 1955) dziedniecības žodzenes (Pētersone, 1958) <b>ārstniecības žodzene</b> (Saveljeva, Zumberga, 1960) tauku zāle (Pētersone, 1961) ceļu žodzenes (Brastiņš, 1969) dziedniecības žodzene (Pētersone, 1980) parastā žodzene (Rasiņš, 1987)
<i>S. altissimum</i>	augstās žodzenes (Galenieks, 1950) <b>augstā žodzene</b> (Galenieks, 1953)
<i>S. orientale</i>	<b>austrumu žodzene</b> (Pētersone, 1980)
<i>S. loeselii</i>	Lezeļa žodzenes (Galenieks, 1950) Lēzeļa žodzene (Rasiņš, 1954) <b>Lēzelā žodzene</b> (Lejiņš et al., 1997)
<i>S. volgense</i>	<b>Volgas žodzene</b> (Saveljeva, Zumberga, 1960)
<i>S. polymorphum</i>	<b>daudzveidīgā žodzene</b> (Fatare, 1998)

Accepted Latvian names are marked in bold.

In the study of genus *Sisymbrium* Latvian names were also examined (Table 2). For species *S. altissimum* which had previous both plural and singular names, the singular was accepted, because the Latin name is in singular. For several species there is no variability in Latvian names used, like *S. supinum*, *S. orientale*, *S. volgense* and *S. polymorphum*. Species *S. orientale*, *S. volgense* and *S. polymorphum* are alien and their distributions are very rare to rather rare, which perhaps is the reason a diversity of species names did not occur. *S. supinum* is also a very rare species. In most cases, species Latvian names are translations from Latin. Priority was given to names approved by the terminology commission and if they complied with the requirements of systematics. Species accepted names in Table 2 are shown in bold.

## DISCUSSION

The first record of the genus *Sisymbrium* in the flora of Latvia was from 1778 when J. Fischer (1778) mentioned *Erysimum officinale* L. (=*Sisymbrium officinale*). *S. officinale* is distributed throughout Europe (Ball, 1964). Its main distribution range is in the temperate zone in Europe, where it is common in ruderal plant communities (Hegi, 1986). In *Latvijas PSR flora* (Eleksis, 1955) *S. officinale* is mentioned as frequent and now *S. officinale* is found throughout the territory.

In 1791, J. Fischer described another species, *S. loeselii* (Fischer, 1791). V. Mühlenbach (1934) reported that *S. loeselii* was very frequent around many railway stations in Riga. *S. loeselii* is common in Central and Eastern Europe,

often introduced in the Western Europe and Northern Europe (Ball, 1964). A. Eleksis (1955) mentioned that *S. loeselii* is rare but that it had become more frequent.

J. Klinge (1882) added another species, *S. sinapistrum* Crantz. (=*S. altissimum*), to the genus, and pointed out that it had spread extensively and can be considered as naturalised. V. Mühlenbach (1934) also confirmed widespread distribution of *S. altissimum* in Riga. A. Eleksis (1955) mentioned that *S. altissimum* is not rare and occurs along roads and is relatively common in adjacent areas of large cities throughout the territory.

*S. volgense* was mentioned by E. Lehmann in 1896 as an alien species to Latvia, which spread with crop seed from the Volga steppe areas. *S. volgense* was found in some places in Riga, where it formed smaller or larger populations (Mühlenbach, 1934; Шулп, 1976). In *Latvijas PSR flora* (Eleksis, 1955) it was mentioned that *S. volgense* was once found in Latvia, but had disappeared. Analysis of herbarium material established new *S. volgense* localities in Latvia. *S. volgense* tended to increase in occurrence of frequency in Latvia and is found mostly near large cities and towns— Riga, Liepāja, Dobeles, Valmiera, Gulbene, Madona, Pļaviņas, Daugavpils, Rēzekne, and Balvi, mainly at railway stations and around anthropogenic habitats. It has become locally naturalised in many European countries and is native to South-Western Russia. In the native area of *S. volgense*, it grows in the steppe as a weed, from where this species has dispersed by wind along railway lines (Oprea and Sirbu, 2010). In Europe, *S. volgense* is found on railway embankments and in stations, harbours, along roads, ruderal areas, around homes, and in fields (Bojnanský and Fargašová, 2007).

V. Rothert (1915) added *S. columnae* Jacq. (=*S. orientale*) to the flora. It was found at the Riga freight station. *S. orientale* was found again in 1961 and 1962 in Riga (Шулп, 1977). *S. orientale* occurs in Southern Europe and frequently is introduced elsewhere (Ball, 1964). In Central Europe *S. orientale* is alien and scattered on ruderal sites (Hegi, 1986).

O. Gautzsch (1939) mentioned *Braya supina* (L.) W. D. J. Koch (=*S. supinum*), which was found around Ķemeri in 1937 and on the shore of Kapieris lake in 1938 (Mühlenbach, 1985). The locality was destroyed by changing of the water level in the lake (Fatare, 2003). Herbarium records indicate that *S. supinum* was last found in 1957 in Lapmežciems. *S. supinum* is found in Estonia where it occurs on rocky shores (Kukk, 1999), in quarries and along roadsides (Kukk and Kull 2005). *S. supinum* is included in the Red Data Book of Latvia (Fatare, 2003) as well as in the Red Data Book of the Baltic Region (Ingelöf et al., 1993) and in the Council Directive on the conservation of natural habitats and of wild fauna and flora (Anonymous, 1992). *S. supinum* is an extinct species in Latvia and only two localities, in the Coastal Lowland, have been recorded. It is possible that its rarity may be due to unsuitable soil conditions. In Öland,

Sweden *S. supinum* is found in dry grasslands containing several fruticose lichens (Löbel and Dengler, 2008).

*S. polymorphum* was first mentioned in the literature only in the second half of the 20th century, in the list of Vascular flora of Latvia, as an alien species (Φatape, 1988). Herbarium analysis confirmed *S. polymorphum* in the flora of Latvia. It is perhaps occasionally introduced by rail transit. Herbarium material was collected in 1936 and 1937 in Rīga, in the surroundings of the Šķirotava railway station, which is its only known locality. *S. polymorphum* is native to Eastern Europe, on steppe and stony slopes, in forests, river terrace, fields and ruderal stands (Bojnanský and Fargašová, 2007). In Lithuania, the list of *Sisymbrium* species is very similar to the species in Latvia and also *S. altissimum*, *S. loeselii*, *S. orientale*, *S. polymorphum* and *S. volgense* are defined as alien species (Gudžinskas, 1997). In Estonia, the *Sisymbrium* species are *S. altissimum*, *S. loeselii*, *S. officinale*, *S. supinum* and *S. volgense*. Species *S. altissimum*, *S. loeselii* and *S. volgense* are considered also as alien. (Kukk and Kull 2005).

Current taxonomic analysis of genus showed that there are seven species in the flora of Latvia. *S. loeselii*, *S. altissimum*, *S. officinale*, *S. polymorphum*, *S. orientale*, and *S. volgense* are mainly found on railway verges, roadsides, waste dumps and wasteland. *S. supinum* is very rare, found on lake shores, and recorded for the last time in the 1950s, around Lapmežciems. Five species of the genus are alien to the flora of Latvia — *S. loeselii*, *S. altissimum*, *S. polymorphum*, *S. orientale*, and *S. volgense*. The distribution of these species varies considerably. Some of them have become relatively common — *S. loeselii*, *S. altissimum*, *S. volgense*. *S. polymorphum* is considered as an ephemeral, and has not been recorded after 1937. As this species has been introduced accidentally, its re-finding is unlikely, but not excluded.

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## ŽODZĒNU GINTS *Sisymbrium* L. LATVIJAS FLORĀ

Sugu skaita ziņā Latvijā viena no lielākajām ģintīm krustziežu Cruciferae Juss. dzimtā ir žodzeņu ģints *Sisymbrium* L., un šajā ģintī ir ne tikai vietējās, bet arī adventīvās sugas. Pirmo reizi pedējo 50 gadu laikā analizēta *Sisymbrium* sugu izplatība mūsu valsts teritorijā. Izplatības dati iegūti no herbārija datiem, literatūras un lauka pētījumiem. *Sisymbrium* sugām Latvijā sastādīta noteikšanas tabula un zinātniskā nomenklatura. Latvijā konstatētas septiņas *Sisymbrium* sugas — zemā žodzene *S. supinum* L., Lēzela žodzene *S. loeselii* L., daudzveidīgā žodzene *S. polymorphum* (Murray) Roth, Volgas žodzene *S. volgense* M. Bieb. ex E. Fourn., augstā žodzene *S. altissimum* L., austru mužodzene *S. orientale* L. un ārstniecības žodzene *S. officinale* (L.) Scop., kuras galvenokārt sastopamas uz dzelzceļa, ielu malās, izgāztuvēs un nezālienēs.