Folia Geobot. Phytotax., Praha, 29: 335-374, 1994

TAXONOMY OF THE GENUS *CARDAMINE* L. (*CRUCIFERAE*) IN THE CARPATHIANS AND PANNONIA. I. *CARDAMINE PRATENSIS* GROUP

Karol Marhold

Institute of Botany, Slovak Academy of Sciences, Dúbravská cesta 14, SK-842 23 Bratislava, Slovakia; fax +42 7 371948, E-mail BOTUKMAR@SAVBA.SAVBA.SK

Keywords: *Brassicaceae*, *Cardamine dentata*, *C. majovskii*, *C. matthioli*, *C. pratensis*, *C. rivularis*, Central Europe, *Cruciferae*, Determination keys, Distribution maps

Abstract: The results of a taxonomic study of the *Cardamine pratensis* group from the Carpathians and Pannonia are presented. Five species are shown to occur in the area studied, namely *Cardamine pratensis* L., *C. matthioli* MORETTI, *C. majovskii* MARHOLD et ZÁBORSKÝ, *C. dentata* SCHULT. and *C. rivularis* SCHUR. Full synonymy, descriptions, chromosome numbers, taxonomic history, distribution data and ecological notes are provided.

INTRODUCTION

According to AL-SHEHBAZ (1988) the genus *Cardamine* L. contains at least 200 species, including approximately 17 species which, in the opinion of the present author, belong to *Dentaria* L. *Cardamine* is a cosmopolitan genus with representatives on all continents except Antarctica.

In the Carpathians and Pannonia this genus is represented by the following species: *Cardamine pratensis* L., *C. matthioli* MORETTI, *C. majovskii* MARHOLD et ZÁBORSKÝ, *C. dentata* SCHULT., *C. rivularis* SCHUR, *C. amara* L., *C. flexuosa* WITH., *C. hirsuta* L., *C. parviflora* L., *C. impatiens* L., *C. glauca* SPRENG. ex DC., *C. resedifolia* L., *C. trifolia* L., and *C. graeca* L.

This is the first of a series of papers in which it is intended to present a taxonomic revision of the genus *Cardamine* for the Carpathians and Pannonia, including full synonymy, descriptions of taxa, distribution data and ecological notes.

MATERIALS AND ARRANGEMENT OF DATA

The results presented here are based on the study of populations in the field, and the examination of specimens housed at the following herbaria (abbreviations according to HOLMGREN et al. 1990): B, BC, BCC, BM, BP, BRA, BRNM, BRNU, CGE, CL, FI, G, GE, GZU, IB, JE, K, KL, KO, KRA, KRAM, KW, LD, LE, LIM, LINN, LTM, LTR, LW, LWS, M, MMI, NI, O, OL, OXF, PAD, PAV, PR, PRC, RNG, ROZ, SAV, SIB, SLO, TNP, UPS, UU, VER, W, WRSL, WU, Z, ZV, herbaria of Prešov museum and Spišská Nová Ves museum, both in Slovakia, and the University of Szeged, Hungary, and the private herbaria of Prof. M. A. Fischer, Dr W. Gutermann (WU-G), Dr E. Hörandl, Mr J. Hadinec, Prof. A. Jasiewicz

(hb. JAS.), and Prof. J. Mądalski (KRAM-hb. MĄD.). Specimens collected by the author are deposited in SAV.

For each taxon nomenclatural (≡) and taxonomic (=) synonyms are presented, as well as misidentifications and invalid names (-) reported mainly from the area studied. For each name, beneath the heading Ind. loc., information from the protologue is cited concerning the distribution and locality of the original material. Data from the label of the type specimen are presented beneath the Type headings. Chromosome numbers for each taxon are provided. Euploid and dysploid numbers are printed in bold. Other numbers, not in bold, represent aneuploids. Complete data, including precise localities and the location of voucher specimens, are published elsewhere (MARHOLD 1994a). Values in the morphological descriptions in the first two parts of this study are mostly taken from the morphometric studies (MARHOLD 1992, 1994b). The 5% and 95% percentiles are accompanied with 1% and 99% percentiles in brackets.

The distribution of the taxa is presented only at the level of phytogeographical districts (political districts for Romania). The division of the Carpathians and Pannonia is according to ČOPYK (1977), FUTÁK (1980), KONDRACKI (1981), NIKLFELD (1964), SKALICKÝ (1988) and SOÓ (1964). Names and numbers of the phytogeographical units follow the above mentioned works. In the case of Hungary the district of Praeillyricum, excluded from Pannonicum by SOÓ (1964), is included here. Lowlands south of the Romanian Carpathians are also included. No material was examined from former Yugoslavia. The distribution maps are based on herbarium specimens and reliable data from the literature (distribution maps for Romania are not presented due to the lack of detailed local maps).

Keys to the genus *Cardamine* in the Carpathians and Pannonia

Plants in flower

1	Cauline leaves auriculate	2
1*	Cauline leaves not auriculate	4
2	Petals 2.4-3.0 mm long	*C. impatiens*
2*	Petals 4.0-6.5 mm long	3
3	Cauline leaves simple	*C. resedifolia*
3*	At least basal cauline leaves compound	*C. graeca*
4	Petals 2.0-4.0 mm long	5
4*	Petals longer than 4.0 mm	7
5	Plant without rosette leaves	*C. parviflora*
5*	Plant with rosette leaves	6
6	Stamens 4; rosette compact; stem not flexuose	*C. hirsuta*
6*	Stamens 6; rosette not compact; stem flexuose	*C. flexuosa*
7	Plant without rhizome	*C. glauca*
7*	Plant with rhizome	8
8	Leaves ternate; cauline leaves 0-1 (-3)	*C. trifolia*
8*	At least some leaves pinnate or pinnatisect; cauline leaves 2 or more	9
9	Rhizome long, repent; basal leaves not forming rosette; stigma not conspicuous	*C. amara*

9*	Rhizome short, not repent; basal leaves forming rosette; stigma conspicuous	*C. pratensis* group

Plants in fruit

1	Cauline leaves auriculate	2
1*	Cauline leaves not auriculate	4
2	Siliquae 3.0-4.5 mm wide	*C. graeca*
2*	Siliquae 1.0-1.4 mm wide	3
3	Rosette leaves preserved	*C. resedifolia*
3*	Rosette leaves shrivelled	*C. impatiens*
4	Infrutescence secund	*C. glauca*
4*	Infrutescence not secund	5
5	Plant without rhizome	6
5*	Plant with rhizome	8
6	Plant without rosette leaves	*C. parviflora*
6*	Plant with rosette leaves	7
7	Stamens 4; rosette compact; stem not flexuose	*C. hirsuta*
7*	Stamens 6; rosette not compact; stem flexuose	*C. flexuosa*
8	Leaves ternate; cauline leaves 0-1 (-3)	*C. trifolia*
8*	At least some leaves pinnate or pinnatisect; cauline leaves 2 or more	9
9	Rhizome long, repent; basal leaves not forming rosette; stigma not conspicuous	*C. amara*
9*	Rhizome short, not repent; basal leaves forming rosette; stigma conspicuous	*C. pratensis* group

CARDAMINE PRATENSIS GROUP

The results of a multivariate morphometric study of the *Cardamine pratensis* group in the Carpathians and Pannonia (MARHOLD 1994b) showed that four species, namely *C. pratensis* L., *C. matthioli* MORETTI, *C. dentata* SCHULT., and *C. rivularis* SCHUR, and two groups of diploid populations, recognized as informal taxonomic units representing undescribed taxa, occur in the area studied. The first of these, for which I have coined the name "*ucranica*", forms a rather isolated group of populations. It differs from other populations of the *Cardamine pratensis* group in the colour of the petals (pure white), and partly also in the orientation of hairs on the rachis of the rosette leaves, and in the orientation of the basal segments on the mid-cauline leaves. Some populations of the *Cardamine pratensis* group, widespread in the Ukraine to the east of the Carpathians, are, with the exception of ploidy level (probably hexaploid) and pollen grain diameter, probably identical with "*ucranica*". Thus, the decision concerning the taxonomic position of "*ucranica*" cannot be made until detailed evaluation of these populations has been undertaken. The second undescribed taxon, which has frequently been refered to as *C. rivularis* SCHUR (see synonymy), is here considered distinct from this species and provisionally named "*rivularis* auct. non SCHUR". Within "*rivularis* auct." are included populations which differ from other populations of the *C. pratensis* group in chromosome number (2n = 16) and geographical distribution (upper montane and subalpine belts of the East Carpathians). Morphologically, however, they differ only slightly from

populations of *C. pratensis* with 2n = 30, 38 and 44 from the area studied. The major difference between these populations is the diameter of the pollen grains. The populations of "*rivularis* auct." have been identified incorrectly in the past as either *C. pratensis* "proles" *crassifolia* (POURR.) O.E. SCHULZ or *C. rivularis* SCHUR. *C. crassifolia* POURR., however, occurs only in the Pyrenees and differs from "*rivularis* auct." in having a stoloniferous rhizome. *C. rivularis*, as here circumscribed, occurs only in the South Carpathians and some Bulgarian mountains. It differs from "*rivularis* auct." and from the populations in the Alps, Apennines, Massif Central and Vosges previously treated by most authors as *C. rivularis* in having purplish anthers prior to dehiscence, terminal leaflets of the basal leaves approximately the same size as the lateral ones, and appressed hairs on the rachis of the basal leaves. The relationships between "*rivularis* auct.", diploid populations of *C. rivularis* auct. non SCHUR from the Alps, and diploid populations of *C. pratensis* s.str., reported by URBANSKA-WORYTKIEWICZ & LANDOLT (1974) from north of the Alps [near Lake Constance (Bodensee)], are still not fully understood. The taxonomic position of "*rivularis* auct." may only be ascertained after careful comparison with these populations.

The distribution of the species of the *Cardamine pratensis* group in the area studied partially overlap and some of them occur even at the same localities. The occurrence of a hybrid between *C. pratensis* and *C. matthioli* (*C.* × *smejkalii* TOMŠOVIC) has been reported by TOMŠOVIC (1986), but no other hybrids were confirmed during the present study.

Most of the above is also accepted in the account of the *Cardamine pratensis* group in the second edition of Flora Europaea, revised by the present author (MARHOLD 1993). Because of the species concept adopted by the editors for the *C. pratensis* group in this new edition, taxa within the group are presented in Flora Europaea at the subspecific level.

Key to the species of the *Cardamine pratensis* group in the Carpathians and Pannonian

1	Cauline leaves pinnate; leaflets distinctly stalked	*C. dentata*
1*	At least upper cauline leaves pinnatisect	2
2	At least some basal leaves hairy	3
2*	Basal leaves glabrous or shrivelled at anthesis	5
3	Hairs on rachis of basal leaves patent	*C. pratensis*
3*	Hairs on rachis of basal leaves appressed	4
4	Petals purple; anthers purplish before dehiscence	*C. rivularis*
4*	Petals white or pale reddish-violet; anthers yellow before dehiscence	7
5	Basal segments of mid-cauline leaves slightly ascending	6
5*	Basal segments of mid-cauline leaves slightly deflexed	7
6	Terminal leaflet of basal leaves approximately the same size as lateral ones; anthers purplish before dehiscence	*C. rivularis*
6*	Terminal leaflet of basal leaves much larger than lateral ones; anthers yellow before dehiscence	*C. pratensis*
7	Petals 5.0-9.0 (-12.0) mm long and 2.5-5.5 (-6.0) mm wide; diameter of pollen grains 24.0-27.8 µm (represents range of the mean values calculated from thirty measurements), 2n = 16	*C. matthioli*
7*	Petals 8.5-16.5 mm long and (5.0-) 5.5-12.0 mm wide; diameter of pollen grains 28.3-32.3 µm, 2n = 32	*C. majovskii*

Note: During the identification of *C. matthioli* and *C. majovskii* one must be cautious in the case of extreme ecological conditions (very rich soils in flood plain forests or poor, dry soils) which could, to some extent, influence the size of flower parts. In such cases the measurement of pollen grains is essential. Values of such extremes in variability of petals are not included in the above key and descriptions of these two species (cf. MARHOLD 1994a).

Cardamine pratensis L.

Cardamine pratensis L. Sp. Pl.: 656, 1753.
Ind. loc.: "In Europae pascuis aquosis". Lectotypus: (LINN, no. 835.15) (most probably KHATRI 1989: 92).

= *Cardamine pratensis* var. *parvifolia* WIMM. et GRAB. Fl. Siles. 2/1: 266, 1829.
Ind. loc.: sine. Typus ignotus.

= *Cardamine pratensis* var. *pubescens* WIMM. et GRAB. Fl. Siles. 2/1: 266, 1829.
Ind. loc.: "Bei Leobschütz (Schramm)". Typus ignotus.

= *Cardamine pratensis* var. *grandiflora* ENDL. Fl. Poson.: 385, 1830.
Ind. loc.: "[Posonium] In sylvulis insulae Mühlau." Lectotypus vel neotypus (**hoc loco designatus**): Poson, s. a., ENDLICHER (W).

= *Cardamine pratensis* var. *grandiflora* NEILR. Fl. Nied. - Oesterr.: 718, 1859 non ENDL. Fl. Poson.: 385, 1830 (nom. illegit.).
Ind. loc.: "[Nieder-Österreich]". Lectotypus vel neotypus (**hoc loco designatus**): Hütteldorfer Au, 24.IV.1841, NEILREICH (W-herb. NEILR., no. 10.098).

= *Cardamine pratensis* var. *flore-pleno* NEILR. Fl. Nied. - Oesterr.: 718, 1859.
Ind. loc.: "Bei Angern (A. MATZ); Himberg (HOST); in der Piestingau vor Moosbrunn (JURATZKA); an der Fischa bei Wr. - Neustadt (BILIMEK); Bei Wieselburg im Thale der Kleinen Erlaf (REINEGGER)". Neotypus (**hoc loco designatus**): Bei Wr. Neustadt, 11.V.1851, NEILREICH (W-herb. NEILR.).

= *Cardamine pratensis* var. *dentata* SCHUR Enum. Pl. Transsilv.: 48, 1866 non WIMM. et GRAB. Fl. Siles. 2/1: 266, 1829 (nom. illegit.).
Ind. loc.: "Am Bäresbach bei Heltau". Lectotypus (**hoc loco designatus**): Am Bäresbach bei Heltau, s. a. [collected before 1861], SCHUR (LW).

= *Cardamine pratensis* var. *macrantha* SCHUR Enum. Pl. Transsilv.: 48, 1866.
Ind. loc.: "Am Zibin- und Zoodfluss bei Talmatsch". Lectotypus (**hoc loco designatus**): locus difficilis ad legendum, 30.IV.1854, SCHUR (LW).

= *Cardamine pratensis* var. *pleniflora* SCHUR Verh. Naturf. Vereins Brünn 15/2 (1876): 79-80, 1877.
Ind. loc.: "Au bei Grammatneusiedl in Niederösterreich." Typus ignotus.

= *Cardamine pratensis* var. *subrivularis* SCHUR Verh. Naturf. Vereins Brünn 15/2 (1876): 79, 1877.
Ind. loc.: "Bei Bisterz; Komein; am Fusse des Kuhberges bei Jundorf nächst Brünn". Typus ignotus.

= *Cardamine pratensis* var. *grandiflora* SCHUR Verh. Naturf. Vereins Brünn 15/2 (1876): 79, 1877 non ENDL. Fl. Poson.: 385 nec NEILR. Fl. Nied.-Oesterr.: 718, 1859 (nom. illegit.).
Ind. loc.: "Um Brünn; oberhalb der Teufelsschlucht; in den Schluchten des Rothen Berges; an der Schwarzawa und Zwittawa." Typus ignotus.

= *Cardamine ullepiciana* BORBÁS Oesterr. Bot. Z. 39: 375-376, 1889.
Ind. loc.: "In Pienninis". Typus ignotus.
≡ *Cardamine pratensis* subsp. *ullepiciana* (BORBÁS) JÁV. ex SOÓ Nomenclator Borbasianus: 21, 1931.

= *Cardamine pratensis* var. *carpatica* ZAPAŁ. Rozpr. Wydz. Mat. - Przyr. Akad. Umiejetn. Dział B, Nauki Biol. Ser. 3, 12: 11-12, 1912.
Ind. loc.: "In Tatris: Molkówka (KOTULA); Jalowiczora ad Czeremosz Biały (WOŁOSZCZAK)". Lectotypus (**hoc loco designatus**): Mlaka na Molkówce, 16.VIII.1885, KOTULA (KRAM, no. 112221).

= *Cardamine pratensis* subsp. *major* TOMŠOVIC Folia Geobot. Phytotax. 21: 429, 1986.
Ind. loc.: "Distr. Uherské Hradiště, in silva Singulární les, ad oppidum Uherský Ostroh (PODPĚRA & KUNOVSKÝ 27.4.1935)". Holotypus: Distr. Uherské Hradiště, in silva Singulární les, ad oppidum Uherský Ostroh, 27.IV.1935, PODPĚRA & KUNOVSKÝ (PR, no. P4T 4486).

? = *Cardamine pratensis* var. *pseudo-hirsuta* SCHUR Enum. Pl. Transsilv.: 48, 1866. Ind. loc.: "Bei Reussen, bei Hermannstadt." Typus ignotus.

- *Cardamine pratensis* subsp. *genuina* ČELAK. Prodr. Fl. Böhmen: 450, 1875 (nom. invalid.).
- *Cardamine pratensis* var. *typica* BECK Fl. Nieder-Österreich: 454, 1892 (nom. invalid.).
- *Cardamine pratensis* var. *dentata* auct. non (SCHULT.) WIMM. et GRAB.: RCHB. Fl. Germ. Excurs.: 676, 1832; W.D.J. KOCH Syn. Fl. Germ. Helv. 1: 44, 1835; NEILR. Fl. Nied.-Oesterr.: 718, 1859; NYÁR. in SÁVUL. Fl. Reip. Pop. Roman. 3: 270, 1955.
- *Cardamine pratensis* var. *palustris* auct. (p.p.) non WIMM. et GRAB.: NYÁR. in SÁVUL. Fl. Reip. Pop. Roman. 3: 269, 1955.
- *Cardamine rivularis* auct. non SCHUR: ČOPYK Vysokohirna Fl. Ukr. Karpat: 50, 1976; ČOPYK Vyznačnyk Roslyn Ukr. Karpat: 133, 1977; SPASSKAJA Vestn. Leningradsk. Univ., Ser. Biol. 1973 (3): 131-135, 1973; Ibid. 1978 (15): 62, 1978; KOTOV in FED. Fl. Part. Eur. URSS 4: 90, 1979; PROKUDIN Opredelitel' Vyssich Rastenij Ukr.: 121, 1987. [= "*rivularis* auct."].
- *Cardamine pratensis* subsp. *hayneana* var. *rivularis* auct. (p.p.), non (SCHUR) NYÁR.: NYÁR. in SÁVUL. Fl. Reip. Pop. Roman. 3: 270, 1955. [= "*rivularis* auct."].
- *Cardamine pratensis* "proles" *crassifolia* auct. (p.p.) non (POURR.) O.E. SCHULZ: O.E. SCHULZ Bot. Jahrb. Syst. 32: 533, 1903; JÁV. Magyar. Fl.: 425, 1924 [= "*rivularis* auct."].

Exsiccata visa

Fl. Exs. Reipubl. Bohem. Slov. no.220 (BRNM, CL, K, OL, PR, PRC, SLO, WU), no. 1026 (ut *C. pratensis* var. *palustris* WIMM. et GRAB.) (BRNU, BRNM, CL, PR, PRC, K, NI, OL, SLO, W, WU, ZV) - Fl. Polon. Exs. no.23 (BM, CGE, CL, KRA, KRAM, W), no. 217 (BM, CGE, CL, KRA, OXF, PR, RNG) - SCHULTZ Herb. Norm. no. 2806 (BM, OXF, PRC, W);

Extra fines: Fl. Jutl. Exs. no. 848 (BRNU, CGE, CL, KRAM, PRC, W) - Fl. Siles. Exs. no. 54 (BRNU, CGE, CL, KRAM, PR, PRC, W) - PETRAK Fl. Bohem. Morav. Exs. no. 822 (BM, BRNU, PR, PRC) - TAUSCH Herb. Fl. Bohem. no. 124 (PRC) - Fl. Krol. Polsk. no. 574 (LD).

Icones

DOSTÁL Květ. ČSR: 291, tab. 95, fig. 2, 1948. - DOSTÁL Klíč Květ. ČSR: 201, fig. 345-I, 1954. - DOSTÁL Nová Květ. ČSSR: 359, tab. 89, fig. 6, 1989. - HEJNÝ & SLAVÍK Květ. ČR 3: 95, tab. 20, fig. 2, 1992. - JÁVORKA & CSAPODY Icon. Fl. Part. Austro-Orient. Eur. Centr.: 200, fig. 1524, 1975. - LINDMAN Nord. Fl. 2: fig. 268a, 1964. - MĄDALSKI Fl. Polon. Terrarum. Adiacent. Icon. 9/4: fig. 1084, 1966. - NYÁRÁDY in SÁVULESCU Fl. Reip. Pop. Roman. 3: 261, tab. 45, fig. 2, 1955. - POLÍVKA, DOMIN & PODPĚRA Klíč Květ. Československ.: 48, fig. 66, 1928. - REICHENBACH Icon. Fl. Germ. Helv. 2: fig. 4308, 4308ß, 1837-1838. - ROTHMALER Exkursionsfl., ed. 6, 3: 159, 1987. - SCHLECHTENDAL, LAGENTHAL & SCHENK Fl. Deutschl., ed. 5, 14: fig. 1366, 1883.

Icones nostrae: Fig. 1 (*C. pratensis* L.), Fig. 2 ("*rivularis* auct."), Fig. 3 ("*ucranica*").

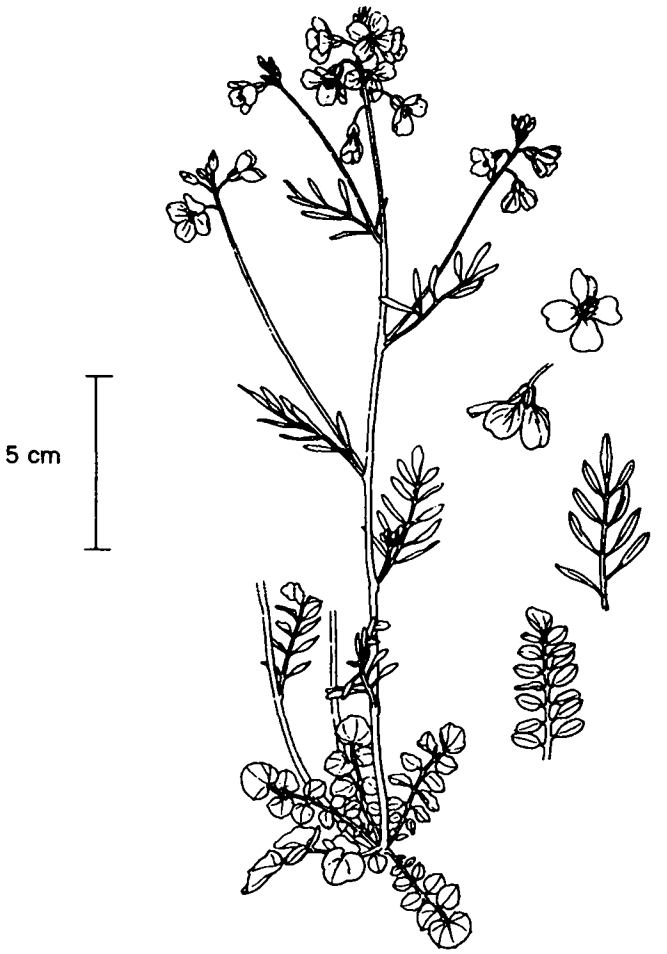

Fig. 1. *Cardamine pratensis* L. (details of flowers enlarged).

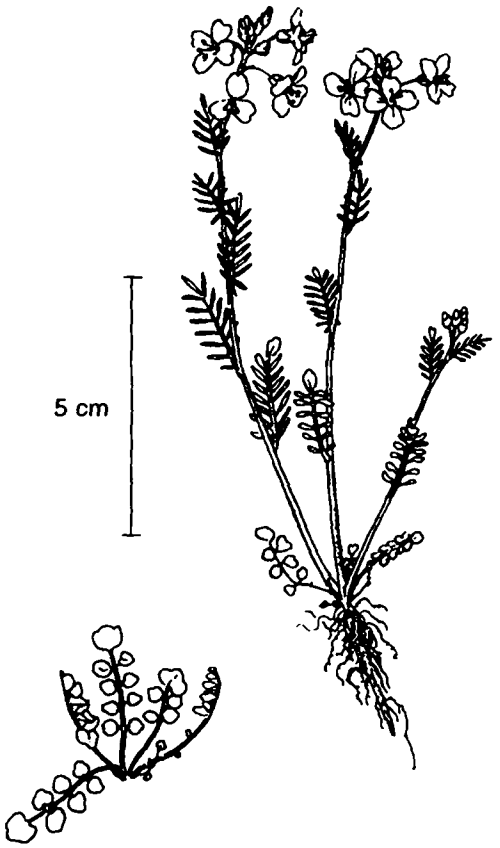

Fig. 2. *Cardamine "rivularis* auct."

Taxonomic history

The lectotype of *Cardamine pratensis* most probably originated from the north or west European populations with a chromosome number of 2n = 30. There are various opinions, however, concerning the circumscription of this taxon. Even in the very strict sense adopted by LANDOLT (1984) this species is very heterogeneous, including several polyploid levels (diploids, tetraploids and hexaploids).

URBANSKA-WORYTKIEWICZ & LANDOLT (1974) referred to *Cardamine udicola* JORD. from Czechoslovakia and Poland, without citing a specific locality. This species, which occurs in Switzerland, Bavaria, and Upper Austria (according to the above-mentioned authors), is not found in the Carpathians. Herbarium specimens from this area at GZU and M, identified by Landolt as *C. udicola*, for the most part belong to *C. pratensis* s.str. and in one case to "*rivularis* auct."

As shown by the results of the multivariate morphometric analysis of the *C. pratensis* group in the Carpathians and Pannonia (MARHOLD 1994a), *C. pratensis* subsp. *major* TOMŠOVIC (1986), described from the flood-plain forests surrounding the River Morava in Moravia, is not morphologically distinct from the type subspecies of *C. pratensis* in the sense of TOMŠOVIC. TOMŠOVIC (1986), in his description of *C. pratensis* subsp. *major*, stressed the height of the stem and the length and colour of the petals as distinguishing characters. In cultivation experiments undertaken by the present author (MARHOLD, unpubl.), it was found that the height of the stem of *C. pratensis* is influenced by ecological factors, and thus can not be considered as a reliable character for distinguishing infraspecific taxa within this species. Petals of 11-13 mm long [longer than in the type subspecies according to TOMŠOVIC (1986)] are not only

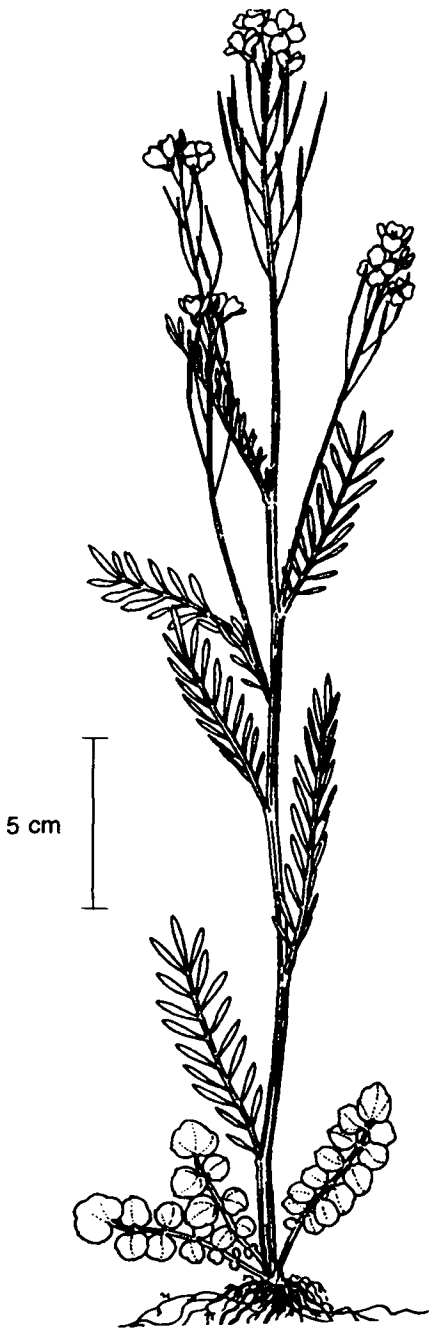

Fig. 3. *Cardamine* "*ucranica*".

characteristic of the populations from the flood-plain forests, but also of hexaploid populations of *C. pratensis* from the West Carpathians, treated by TOMŠOVIC as *C. pratensis* subsp. *pratensis*. Petal colour is also found to be unreliable as a distinguishing character between infraspecific taxa within *C. pratensis*.

Brief description

Perennial herb, 15-50 cm tall. Rhizome short, usually simple. Stem erect, simple, rarely branched at base and above, glabrous. Rosette leaves usually with patent hairs, occasionally glabrous, pinnate, with 1-10 pairs of sessile or petiolulate, broadly ovate to circular, lateral leaflets; terminal leaflet much larger than lateral ones, 5-45 mm wide, reniform to broadly cuneate at base, entire or crenate to sinuate. Cauline leaves 2-7 (-13) ["*ucranica*" (2-) 3-10 (-11), "*rivularis* auct." 3-8 (-10)] glabrous, pinnatisect (the first and second lowermost leaves rarely pinnate), lower cauline leaves with (1-) 2-7 (-10) pairs of segments ["*ucranica*" (2-) 4-8 (-11) pairs, "*rivularis* auct." (2-) 3-8 (-9) pairs], the number of segments diminishing gradually up the stem, segments oblanceolate to narrowly linear, entire or rarely crenate, usually slightly ascending. Inflorescence racemose; sepals (2.8-) 2.9-5.2 (-5.6) mm long ["*ucranica*" (2.8-) 2.9-4.2 (-4.5) mm, "*rivularis* auct." (2.6-) 2.9-4.2 (-4.5) mm], margin membranous; petals pale reddish-violet to reddish-violet ["*ucranica*" white, "*rivularis* auct." reddish-violet], obovate, (6.8-) 7.5-14.9 (-16.0) mm long × (3.5-) 4.0- 9.4 (-9.9) mm wide ["*ucranica*" (7.5-) 8.3-11.5 (-12.5) × (4.0-) 4.3-6.9 (-7.1) mm, "*rivularis* auct." (6.1-) 7.1-10.2 (-11.1) × (3.5-) 4.0-6.4 (-6.9) mm]; stamens 6, anthers yellow before anthesis, filaments of longer stamens (3.5-) 4.0-8.3 (-8.7) mm long ["*ucranica*" (3.5-) 3.8-5.0 (-5.4) mm, "*rivularis* auct." (3.8-) 4.2-6.1 (-6.2) mm],

filaments of shorter stamens (1.9-) 2.3-5.6 (-5.9) mm long ["*ucranica*" (1.7-) 2.3-3.5 (-3.8) mm, "*rivularis* auct." (1.9-) 2.1-3.5 (-3.8) mm]; stigma conspicuous, enlarged. Range of the means of pollen grain diameter calculated for one plant 27.29-35.72 µm ["*ucranica*" 24.31-27.39 µm, "*rivularis* auct." 24.76-28.84 µm]. Pedicels patent or erect- patent, siliquae divergent from axis at the same angle as pedicels or erect, 10.0-40.0 mm long × 1.2-1.8 (-1.9) mm wide.

Flowering: April - May ("*rivularis* auct." June).

2n = **30**, 32, **38**, **44**, 48

- "*rivularis* auct." 2n = **16**, 17, 24

- "*ucranica*" 2n = **16**

General distribution

Cardamine pratensis occurs throughout most of Europe. South of the Pyrenees, the Alps and the Carpathians it is rare. Its distribution extends eastwards to Siberia and the Far East and southwards to North Africa. It was probably introduced by man into North America and New Zealand. The taxonomic position of the extra-European populations requires further study.

Distribution in the Carpathians and Pannonia

Cardamine pratensis is widespread throughout the Carpathians, but in Pannonia it is mainly restricted to the neighbourhood of the major rivers where it occurs in flood-plain forests. Diploids are found in the East Carpathian foothills and at lower altitudes of some Ukrainian East Carpathian mountains (populations of "*ucranica*"), and in the uppper montane and subalpine belt of the East Carpathians (populations of "*rivularis* auct."). Pollen grain measurements suggest the presence of other diploids at low altitudes in the Romanian Carpathians.

Poland (Fig. 4)

Karpaty Zachodnie. 513.33. Pogórze Wielickie, 513.34. Pogórze Wiśnickie, 513.45. Beskid Śląski, 513.46. Kotlina Żywiecka, 513.47. Beskid Mały, 513.48. Beskid Makowski, 513.49. Beskid Wyspowy, 513.51. Beskid Żywiecki, 513.52. Gorce, 513.53. Kotlina Sądecka, 513.62. Pogórze Ciężkowickie, 513.66. Obniżenie Gorlickie, 513.69. Pogórze Bukowskie, 513.71. Beskid Niski, 514.11. Kotlina Orawsko-Nowotarska, 514.12. Pieniny, 513.13. Pogórze Spisko-Gubałowskie, 514.14. Rów Podtatrzański, 514.52. Tatry Zachodnie, 514.53. Tatry Wschodnie. - **Beskidy Wschodnie.** 522.12. Bieszczady Zachodnie.

Moravia (Fig. 4)

Pannonicum. 16. Znojemsko-brněnská pahorkatina, 18a. Dyjsko-svratecký úval, 18b. Dolnomoravský úval, 19. Bílé Karpaty stepní, 20a. Bučovická pahorkatina, 20b. Hustopečská pahorkatina, 21a. Hanácká pahorkatina, 21b. Hornomoravský úval. - **Mesophyticum carpaticum.** 76a. Moravská brána vlastní, 77a. Ždánický les, 77c. Chřiby, 78. Bílé Karpaty lesní, 79. Zlínské vrchy, 80a. Vsetínská kotlina, 81. Hostýnské vrchy, 82. Javorníky, 83. Ostravská pánev, 84a. Beskydské podhůří. - **Oreophyticum carpaticum.** 99a. Radhošťské Beskydy.

Slovakia (Fig. 4)
Pannonicum. 2. Ipeľsko-rimavská brázda, 3. Slovenský kras, 4. Záhorská nížina, 5. Devínska Kobyla, 6. Podunajská nížina. - **Carpaticum occidentale.** 10. Malé Karpaty, 11. Považský Inovec, 12. Tríbeč, 13. Strážovské a Súľovské vrchy, 14a. Pohronský Inovec, 14b. Vtáčnik, 14c. Kremnické vrchy, 14d. Poľana, 14e. Štiavnické vrchy, 14f. Javorie, 15. Slovenské rudohorie, 16. Muránska planina, 17. Slovenský raj, 18. Stredné Pohornádie, 21a. Malá Fatra (Lúčanská Fatra), 21b. Malá Fatra (Krivánska Fatra), 21c. Veľká Fatra, 21d. Chočské vrchy, 22. Nízke Tatry, 23a. Západné Tatry, 23b. Vysoké Tatry, 23c. Belianske Tatry, 24. Pieniny, 25. Turčianska kotlina, 26a. Liptovská kotlina, 26b. Spišské kotliny, 27b. Javorníky, 28. Západné Beskydy, 29. Spišské vrchy, 30a. Šarišská vrchovina, 30b. Čergov, 30c. Nízke Beskydy. - **Carpaticum orientale.** 31. Bukovské vrchy.

Austria (Fig. 5)
Several localities in the vicinity of the Rivers Donau, March and Leitha.

Hungary (Fig. 5)
I. Matricum. 5. Neogradense. - **II. Bakonyicum.** 3. Vesprimense. - **III. Praenoricum.** 2. Castriferreicum. - **IV. Eupannonicum.** 1. Arrabonicum, 2. Colocense, 3. Praematricum. - **V. Praeillyricum.** 2. Somogyicum.

Ukraine (Fig. 6)
Carpaticum orientale. I. Prykarpattja, II. Schidni Beskidy j Nyz'ki Polonyny, III. Gorgany, IV. Svydovec', V. Čornohora, VI. Čyvčyno-Grynjavs'ki hory, VIII. Vulkanični Karpaty.

"*rivularis* auct." (Fig. 8)
Carpaticum orientale. III. Gorgany, IV. Svydovec', V. Čornohora, VI. Čyvčyno-Grynjavs'ki hory, VII. Marmaros'ki Al'py.

"*ucranica*" (Fig. 9)
Carpaticum orientale. I. Prykarpattja, II. Schidni Beskidy j Nyz'ki Polonyny, III. Gorgany.

Romania
Districts Bistriţa-Năsăud, Mureş, Harghita, Sibiu, Hunedoara, Alba, Arad, Cluj.

"*rivularis* auct."
Districts Maramureş, Bistriţa-Năsăud, Suceava [?], Braşov, Bihor, Cluj (in the mountains of Rodnei, Suhardului, Bihorului, and Muntele Mare).

Maximum altitude (excl. "*rivularis* auct." and "*ucranica*"): Slovakia, Nízke Tatry Mts, top of Mt. Salatín, 1627 m, 1985, MARHOLD (SAV).

"*rivularis* auct."
Minimum altitude: Romania, distr. Bistriţa-Năsăud, Izvoru Roşu Valley, 700-900 m, 1923, BORZA (CL).

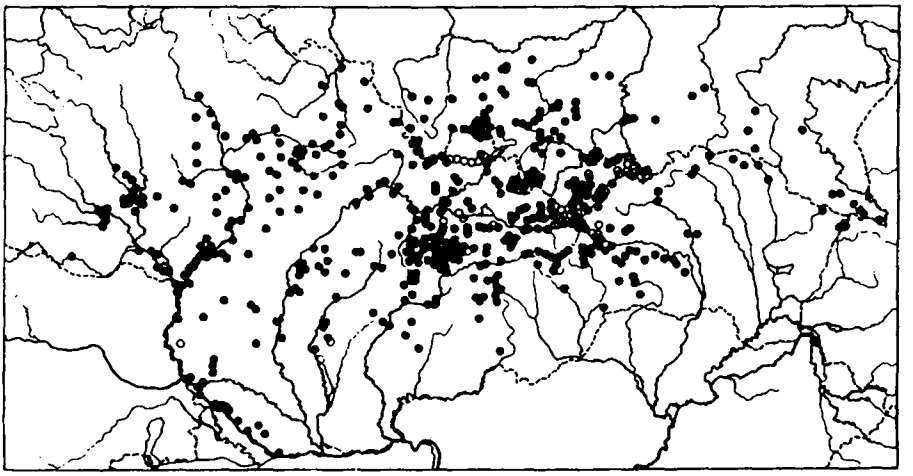

Fig. 4. Map of the distribution of *Cardamine pratensis* L. in the Carpathian and Pannonian part of Poland and Moravia and in Slovakia (● - herbarium specimens, ○ - data from the literature).

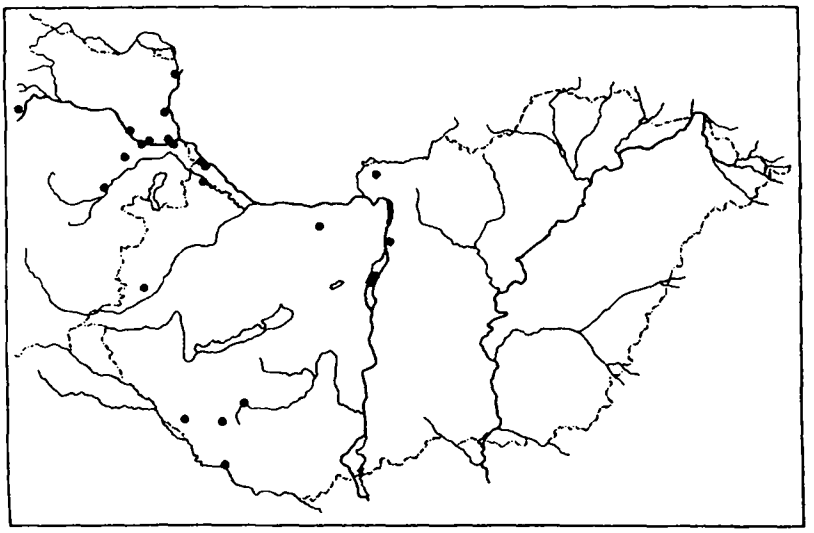

Fig. 5. Map of the distribution of *Cardamine pratensis* L. in the Pannonian part of Austria and in Hungary.

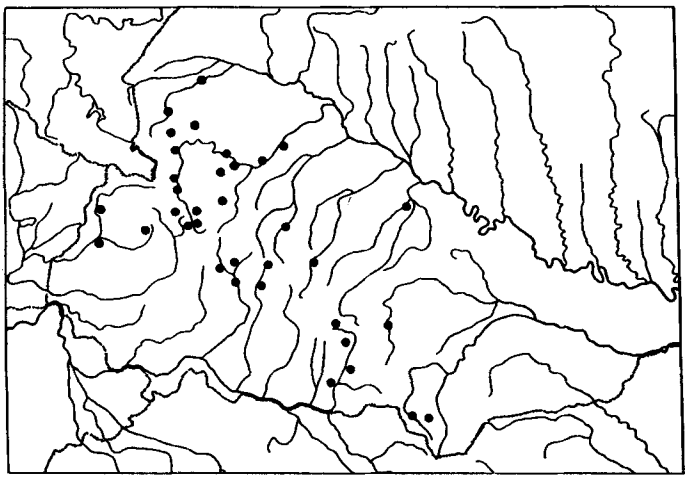

Fig. 6. Map of the distribution of *Cardamine pratensis* L. in the Carpathian part of Ukraine.

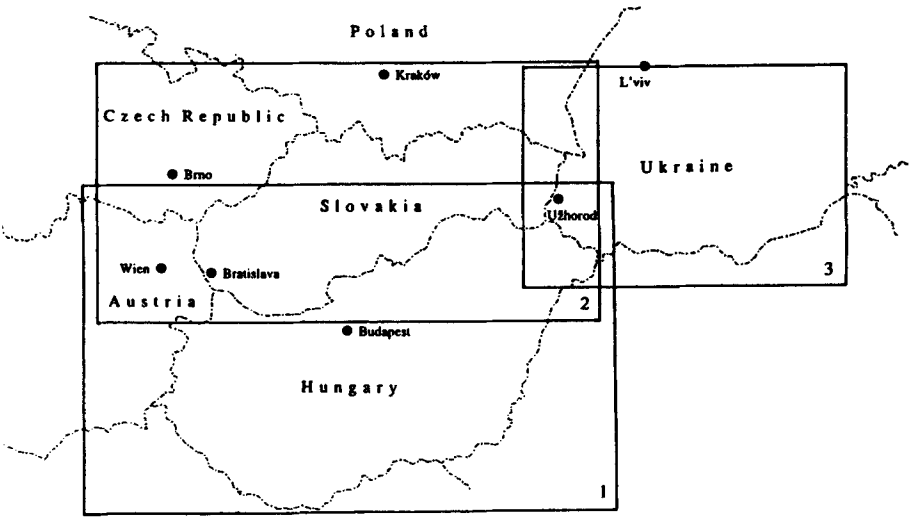

Fig. 7. Scheme of the distribution maps: 1 - Austria and Hungary; 2 - Moravia (Czech Republic), Poland, and Slovakia; 3 - Ukraine.

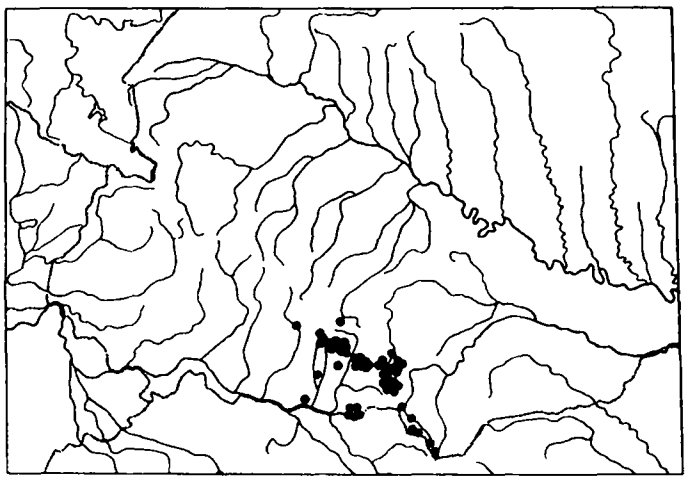

Fig. 8. Map of the distribution of *Cardamine "rivularis* auct." in the Carpathian part of Ukraine.

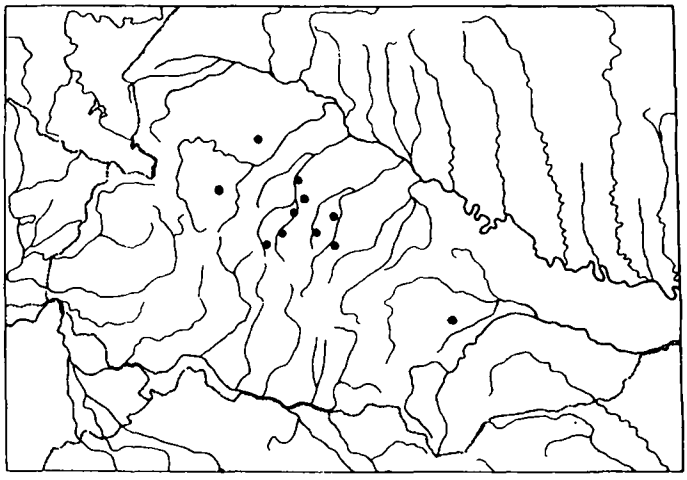

Fig. 9. Map of the distribution of *Cardamine "ucranica"* in the Carpathian part of Ukraine.

Maximum altitude: Ukraine, Čornohora Mts, Mt. Brebeneskul, 1900-2000 m, 1935 PAWŁOWSKI (KRAM), the data of ZAPAŁOWICZ (1889) from the same locality, and from the altitudes 1950 and 2000 m, also probably belong to "*rivularis* auct."; Romania, distr. Maramureş, Rodnei Mts, Mt. Pietroşu, 2200 m, 1903 PAX (BP).

"*ucranica*":
Minimum altitude: Ukraine, Prykarpattja Mts, between the villages of Dovholuka and Ulyčne, 350 m, 1988, MARHOLD & KAHALO (SAV).
Maximum altitude: Ukraine, Schidni Beskydy j Nyz'ki Polonyny Mts, Vyškiv, 900 m, 1990, MARHOLD & KAHALO (SAV).

Ecology and phytosociology

Cardamine pratensis occurs in damp to wet meadows on various substrates, as well as in alder and flood-plain forests. In its wide sense, including *C. matthioli*, it is a characteristic species of the class *Molinio-Arrhenatheretea* R. TX. 1937.

There are slight differences in the ecology of the different chromosome races of this species. It seems that populations with 2n = 44, in the middle altitudes of the Carpathians, occupy relatively dry habitats of the alliance *Arrhenatherion elatioris* KOCH 1926. In lowland areas these populations can be found in communities of the alliances *Alnion glutinosae* MALCUIT 1929 and *Alno-Ulmion* BR.-BL. et R. TX. ex TSCHOU 1948 em. TH. MÜLLER et GÖRS 1958. The populations with 2n = 30 are found in wetter habitats, often with standing water (in the Central West Carpathians these populations occur mainly in the community *Valeriano simplicifoliae-Caricetum davallianae* MORAVEC 1966 of the alliance *Caricion davallianae* KLIKA 1934).

Cardamine pratensis also occurs in communities of the following alliances: *Caricion fuscae* KOCH 1926 em. KLIKA 1934, *Petasition officinalis* SILL. 1933, *Caricion rostratae* BAL.-TUL. 1963 and *Caricion gracilis* NEUHÄUSL 1959.

Populations of "*rivularis* auct." occur in wet meadows, springs, and on stream banks on various substrates. They are reported from communities of the alliances *Caricion lasiocarpae* VAN DEN BERGH. ap. LEBRUN et al. 1949 and *Caricion canescenti-nigrae* NORDHAG. 1936 from the Rodnei Mts (COLDEA 1990).

Populations of "*ucranica*" were found in flood-plain meadows.

Cardamine matthioli MORETTI

Cardamine matthioli MORETTI Giorn. Imp. Reale Ist. Lombardo Sci. 8: 623; Giorn. Imp. Reale Ist. Lombardo Sci. & Bibliot. Ital. 16: 359. 18 Aug. 1847.
Ind. loc.: "Lombardia". Lectotypus vel neotypus (MARHOLD & RAYNER 1994): Province di Lombardia, s. a., MORETTI (FI).
≡ *Cardamine pratensis* var. *matthioli* (MORETTI) ASCH. et KANITZ Cat. Cormophyt. Anthophyt. Serbiae: 75, 1877.
≡ *Cardamine pratensis* subsp. *matthioli* (MORETTI) NYMAN Consp. Fl. Eur.: 36, 1878.
= *Cardamine pratensis* var. *hayneana* RCHB. Fl. Germ. Excurs.: 676, 1832 [ut "*C. pratensis* L. var. γ *C. Hayneana* WELW."].
Ind. loc.: "Bei Mauerbach in der Geg. von Wien". Lectotypus vel neotypus (**hoc loco designatus**): Wien, s. a., WELWITSCH (BM).

≡ *Cardamine pratensis* var. *parviflora* NEILR. Fl. Nied. Oesterr.: 718, 1859 (nom. illegit. superfl. - Art. 63).

≡ *Cardamine hayneana* (RCHB.) SCHUR Verh. Naturf. Vereins Brünn 15/2 (1876): 80, 1877.

≡ *Cardamine pratensis* subsp. *hayneana* (RCHB.) PODP. Spisy Přír. Fak. Masarykovy Univ. 1922/12: 25, 1922.

= *Cardamine pratensis* var. *strictissima* SCHUR Verh. Mitth. Siebenbürg. Vereins Naturwiss. Hermannstadt 4: 64, 1853.
Ind. loc.: sine loc. Typus ignotus.

= *Cardamine pratensis* var. *apetala* NEILR. Fl. Nied.-Oesterr.: 718, 1859.
Ind. loc.: "Bei Maria-Brunn". Holotypus: Auf Bergwiesen bei Maria-Brunn, 10.V.1840, NEILREICH (W - herb. NEILR., no. 10.108).

= *Cardamine pratensis* var. *apetala* SCHUR Enum. Pl. Transsilv.: 48, 1866 non NEILR. Fl. Nied.-Oesterr.: 718, 1859 (nom. illegit.).
Ind. loc.: "Fromoasse". Typus ignotus.

= *Cardamine pratensis* var. *micrantha* SCHUR Enum. Pl. Transsilv.: 48, 1866.
Ind. loc.: "Bei Hermannstadt; bei Heltau und Resinar; bei Tusnad an Büdös". Typus ignotus.

= *Cardamine skorpilii* VELEN. Sitzungsber. Königl. Böhm. Ges. Wiss. Prag, Math.-Naturwiss. Cl. 1889/2: 29, 1890 [ut "*škorpili*"].
Ind. loc.: "In pratis alpinis montis Vitoša (ŠKORPIL)". Lectotypus (**hoc loco designatus**): In pratis alpinis m. Vitoša, 1888, ŠKORPIL (PRC).

- *Cardamine pratensis* var. *palustris* auct. (p.p.) non WIMM. et GRAB.: NYÁR. in SÄVUL. Fl. Reip. Pop. Roman. 3: 269, 1955.

Exsiccata visa

BAENITZ Herb. Eur. no.6959 (LD) - DOMIN & KRAJINA Fl. Čechoslov. Exs. no. 256 (BRNU, BRNM, CL, CGE, K, LIM, NI, OL, PR, PRC, SLO, W), no. 257 (BRNU, BRNM, CL, CGE, K, LIM, NI, OL, PR, PRC, SLO, W) - Fl. Exs. Austro-Hung. no.888/II (BM, BRA, CL, K, PR, PRC, SIB, SLO, W, WU) - Fl. Exs. Reipubl. Social. Čechoslov. no. 1416 (ut *C. pratensis* L.) (BRNU, CL, K, LIM, PRC, SAV, SLO, W, WU) - Fl. Rom. Exs. no. 1705 [ut *C. pratensis* f. *fossicola* (GODET) HEGI] (CL, KRA,SIB, W), no. 2762 (ut *C. pratensis* L.) (CL, SIB) - Herb. Norm. Transsilv. no. 284 (ut *C. pratensis* L.) (CL, SIB);

Extra fines: BAENITZ Herb. Eur. no. 7526 (CL, LD, PRC) - DÖRFLER Herb. Norm. no. 4605 (BM, CL, LD, LW, OXF, PR, PRC, WU) - Exs. Pedemontana no. 200 (BM, CGE, K, LD, UPS) - Fl. Exs. Austro-Hung. no. 888/I (BM, BRA, CL, K, PR, PRC, SIB, W, WU) - FIORI & BÉGUINOT Fl. Ital. Exs. ser. II, no. 1676 (BM, K, OXF, WU) - SCHULTZ Herb. Norm. no.1019 (LD, OXF, PRC, WU), no.1917 (ut *C. palustris* PETERM.) (BM, PR, PRC) - TILL Pl. Austriae Exs. no. 279 (WU).

Icones

ASSENOV in JORDANOV Fl. Reip. Pop. Bulg. 4: 435, tab. 79, fig. 1, 1970. - HEJNÝ & SLAVÍK Květ. ČR 3: 95, tab. 20, fig. 3, 1992. - JÁVORKA & CSAPODY Icon. Fl. Part. Austro-Orient. Eur. Centr.: 200, f. 1523, 1975. - NYÁRÁDY in SÄVULESCU Fl. Reip. Pop. Roman. 3: 261, tab. 45, fig. 4, 1955. - REICHENBACH Icon. Fl. Germ. Helv. 2: fig. 4308γ, 1837-1838.

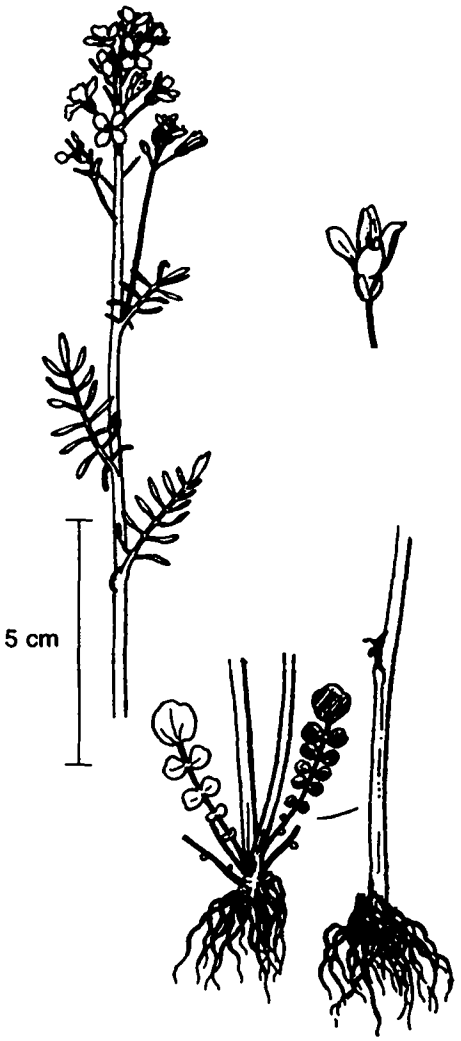

Fig. 10. *Cardamine matthioli* MORETTI (detail of flower enlarged).

Icon nostra: Fig. 10.

Taxonomic history

As stated by REICHENBACH (1837-1838), the first author to recognise this taxon was Hayne, who called it *Cardamine stricta*. This name, however, was never published. The first published name for this taxon was *Cardamine pratensis* var. *hayneana* RCHB., published by REICHENBACH (1830-1832) and based on a specimen he obtained from Welwitsch bearing the name *Cardamine hayneana* WELW. Neither the citations "WELW. in RCHB." or "WELW. ex RCHB." should be used, however, because REICHENBACH changed the status of this name [cf. Art. 46.2 and 46.3 of the Code (GREUTER et al. 1988)]. In several published Floras of the central European area (e.g. NOVÁK 1948) "*Cardamine hayneana* WELW." is presented as the correct name for this taxon at the species level. It appears, however, that WELWITSCH never published this name. The first who did so was probably SCHUR (1877), thirty years after the valid publication of *C. matthioli*.

The taxonomic history of *Cardamine matthioli* has been examined in detail elsewhere (MARHOLD & RAYNER 1994). In this paper it was shown that it was validly published by MORETTI in his "Difesa e illustrazione delle opere botaniche di Pier Andrea Matthioli [,] botanico del XVI secolo" (MORETTI 1847a, b, c). The correct spelling of the epithet of this species is "*matthioli*" not "*matthiolii*" as used by some authors. "*Matthioli*" is correct under Rec. 73C.2 of the Code (GREUTER et al. 1988) (Personal names already in Latin) - i. e. not subject to Rec. 73C.1 (modern personal names) which is enforced by Art. 73.10.

SÓO & ISÉPY (1968) attempted to segregate *C. pratensis* subsp. *matthioli* into two varieties, var. *matthioli* and var. *pseudohirta* SCHUR. It has been shown by MARHOLD (1991) that such a division is not justified.

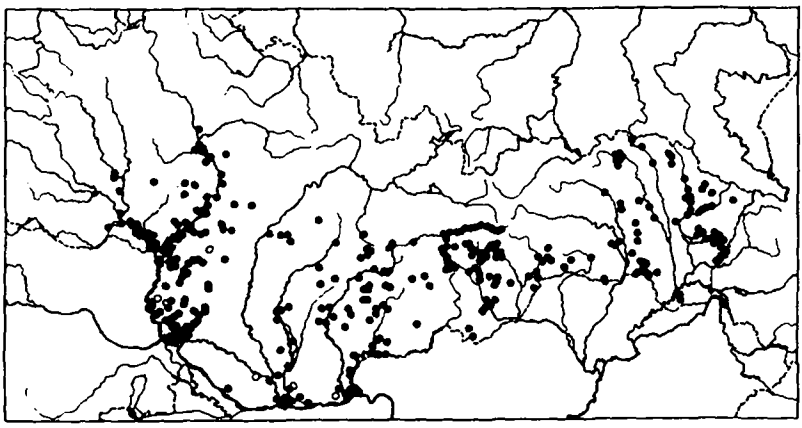

Fig. 11. Map of the distribution of *Cardamine matthioli* MORETTI in the Carpathian and Pannonian part of Moravia and in Slovakia (● - herbarium specimens, O - data from the literature).

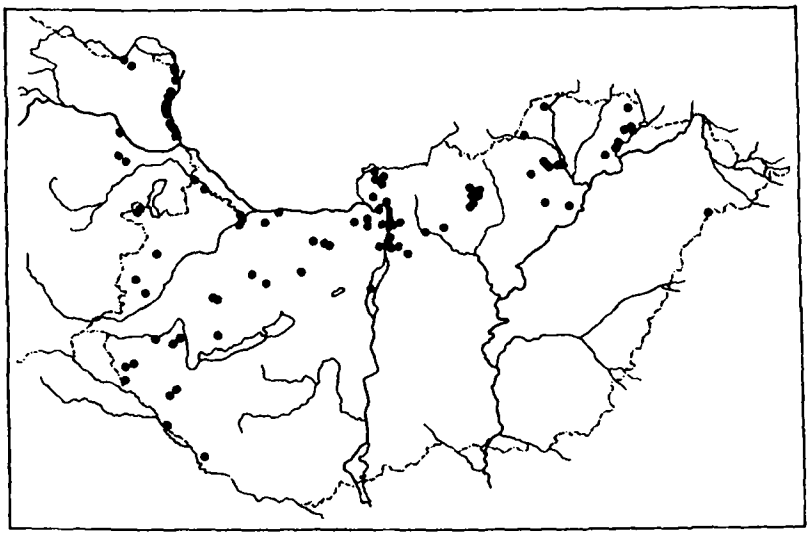

Fig. 12. Map of the distribution of *Cardamine matthioli* MORETTI in the Pannonian part of Austria and in Hungary.

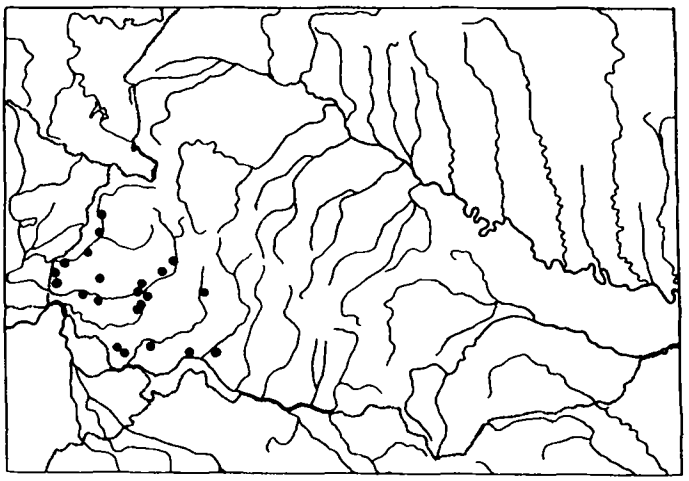

Fig. 13. Map of the distribution of *Cardamine matthioli* MORETTI in the Carpathian and Pannonian part of Ukraine.

Brief description

Perennial herb, 11-50 cm tall. Rhizome short, simple or rarely branched. Stem erect, simple or branched at base and above, glabrous. Most of the immature rosette leaves with dense, rarely sparse, appressed hairs, old rosette leaves glabrous (or shrivelled at anthesis), pinnate, with (2-) 5-8 pairs of sessile or shortly petiolulate, circular to broadly obovate, entire or sharply crenate lateral leaflets; terminal leaflet distinctly larger than lateral ones, reniform to rounded at base, entire or sharply crenate, 5-25 mm wide. Cauline leaves (2-) 3-12 (-18), glabrous, pinnatisect (the first and second lowermost leaves rarely pinnate), lower cauline leaves with (2-) 4-11 (-14) pairs of segments, the number of segments diminishing gradually up the stem, segments linear to oblanceolate, entire, leaflets or segments of the middle and lower cauline leaves horizontally spreading, basal leaflets or segments slightly deflexed. Inflorescence racemose; sepals (2.6-) 2.8-4.3 (-4.7) mm long, margin membranous; petals white or pale reddish-violet, obovate, 5.0-9.0 (-12.0) mm long × 2.5-5.5 (-6.0) mm wide; stamens 6, anthers yellow before anthesis, filaments of longer stamens (3.3-) 3.8-6.2 (-6.9) mm long, filaments of shorter stamens (1.6-) 2.1-4.2 (-4.5) mm long; stigma conspicuous, enlarged. Range of the means of pollen grain diameter calculated for one plant 24.03-27.83 µm. Pedicels patent or erect-patent, siliquae divergent from axis at the same angle as pedicels or erect, 12.0- 34.0 mm long × 0.8-1.3 mm wide.

Flowering: April - May.

2n = **16**, 17, 18, 19, 20, 21

General distribution

Cardamine matthioli occurs in central and southern Europe, the Carpathians, Pannonia, and south of the Alps (from Piemont in the west to Romania and Bulgaria in the east).

Distribution in the Carpathians and Pannonia

Cardamine matthioli is widespread in Pannonia and the Carpathians, where its distribution reaches its northern limit.

Moravia (Fig. 11)

Pannonicum. 16. Znojemsko-brněnská pahorkatina, 18a. Dyjsko-svratecký úval, 18b. Dolnomoravský úval, 19. Bílé Karpaty stepní, 20b. Hustopečská pahorkatina, 21b. Hornomoravský úval . - **Mesophyticum carpaticum.** 77c. Chřiby, 78. Bílé Karpaty lesní.

Slovakia (Fig. 11)

Pannonicum. 1. Burda, 2. Ipeľsko-rimavská brázda, 3. Slovenský kras, 4. Záhorská nížina, 5. Devínska Kobyla, 6. Podunajská nížina, 7. Košická kotlina, 8. Východoslovenská nížina. - **Carpaticum occidentale.** 9. Biele Karpaty (južná časť), 10. Malé Karpaty, 11. Považský Inovec, 12. Tríbeč, 13. Strážovské a Súľovské vrchy, 14a. Pohronský Inovec, 14b. Vtáčnik, 14c. Kremnické vrchy, 14d. Poľana, 14e. Štiavnické vrchy, 14f. Javorie, 15. Slovenské rudohorie, 16. Muránska planina, 18. Stredné Pohornádie, 19. Slanské vrchy, 20. Vihorlatské vrchy, 21a. Malá Fatra (Lúčanská Fatra), 22. Nízke Tatry, 25. Turčianska kotlina, 30a. Šarišská vrchovina, 30b. Čergov, 30c. Nízke Beskydy. - **Carpaticum orientale.** 31. Bukovské vrchy.

Austria (Fig. 12)

Several localities mostly in the vicinity of the Rivers Thaya and March.

Hungary (Fig. 12)

I. Matricum. 1. Tokajense, 2. Tornense, 3. Borsodense, 4. Agriense, 5. Neogradense. - **II. Bakonyicum.** 1. Visegradense, 2. Pilisense, 3. Vesprimense. - **III. Praenoricum.** 1. Laitaicum, 2. Castriferreicum, 3. Petovicum. - **IV. Eupannonicum.** 1. Arrabonicum, 2. Colocense, 3. Praematricum, 4. Crisicum, 5. Nyirsegense. - **V. Praeillyricum.** 1. Saladiense, 2. Somogyicum.

Ukraine (Fig. 13)

Carpaticum orientale. II. Schidni Beskydy j Nyz'ki Polonyny, VIII. Vulkanični Karpaty, IX. Zakarpats'ke peredhir"ja. - **Pannonicum.** X. Zakarpats'ka rivnyna.

Romania

Districts Bistriţa-Năsăud, Mureş, Harghita, Covasna, Prahova, Braşov, Sibiu, Hunedoara, Timiş, Arad, Bihor, Cluj, Satu Mare.

Maximum altitude: Slovakia, Muránska planina Plain, Tisovec, between elevation points 955 and 1027, below the Korimovo Saddle, 950-1020 m, 1970, MÁJOVSKÝ (SLO).

Ecology and phytosociology

Cardamine matthioli occurs in flood-plain and slightly wet or dry meadows on various substrates. It grows in communities of the alliances *Arrhenatherion elatioris* KOCH 1926, *Alopecurion pratensis* PASS. 1964, and *Caricion gracilis* NEUHÄUSL 1959.

Cardamine majovskii MARHOLD et ZÁBORSKÝ

Cardamine majovskii MARHOLD et ZÁBORSKÝ Preslia 58: 194, 1986.
Ind. loc.: "Slovakia orientalis, distr. Východoslovenská nížina: situ occid. a pago Leles, prope bracchium mortuum "Tica" dictum, MARHOLD 24.4.1985)". Holotypus: Slovakia orientalis, distr. Východoslovenská nížina: situ occid. a pago Leles, prope bracchium mortuum "Tica" dictum, 24.IV.1985, MARHOLD (SAV); isotypus: (SLO).

? = *Cardamine hayneana* var. *iliciana* FRITSCH Verh. K. K. Zool.-Bot. Ges. Wien 44 (1894): 321, 1895 [ut "*ilićiana*"].
Ind. loc.: "Südserbien Jajna; Suschitza (ILIĆ)". Lectotypus (**hoc loco designatus**): Jajna, 1890 ILIĆ (WU).

- *Cardamine pratensis* subsp. *hayneana* var. *hayneana* auct. (p.p.) non (RCHB.) PODP.: NYÁR. in SÁVUL. Fl. Reip. Pop. Roman. 3: 270, 1955.

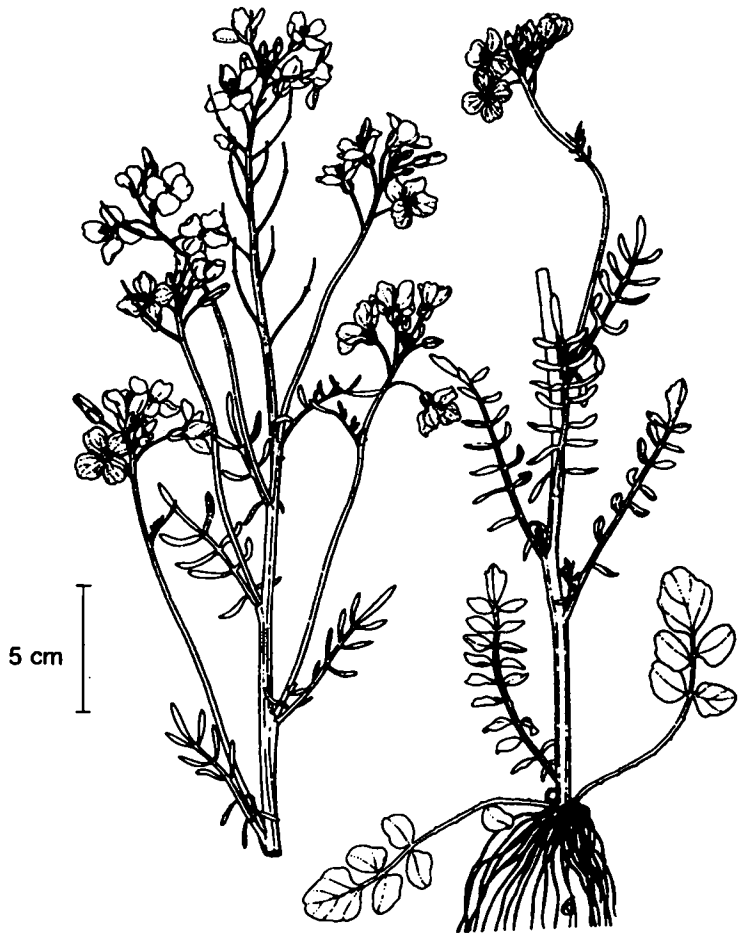

Fig. 14. *Cardamine majovskii* MARHOLD et ZÁBORSKÝ.

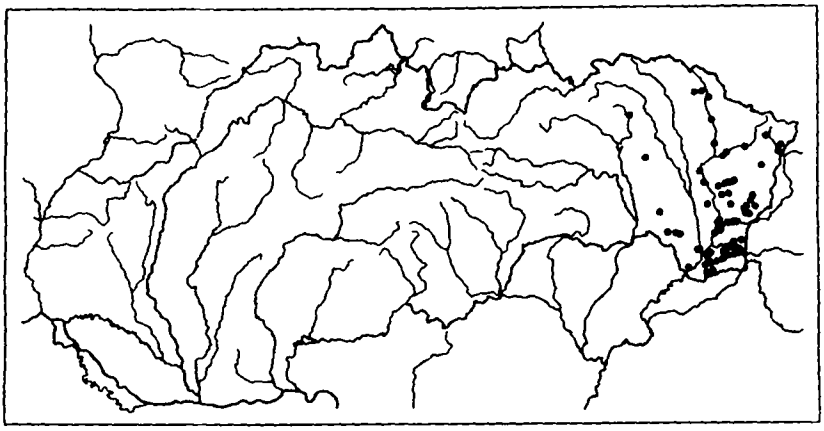

Fig. 15. Map of the distribution of *Cardamine majovskii* MARHOLD et ZÁBORSKÝ in Slovakia.

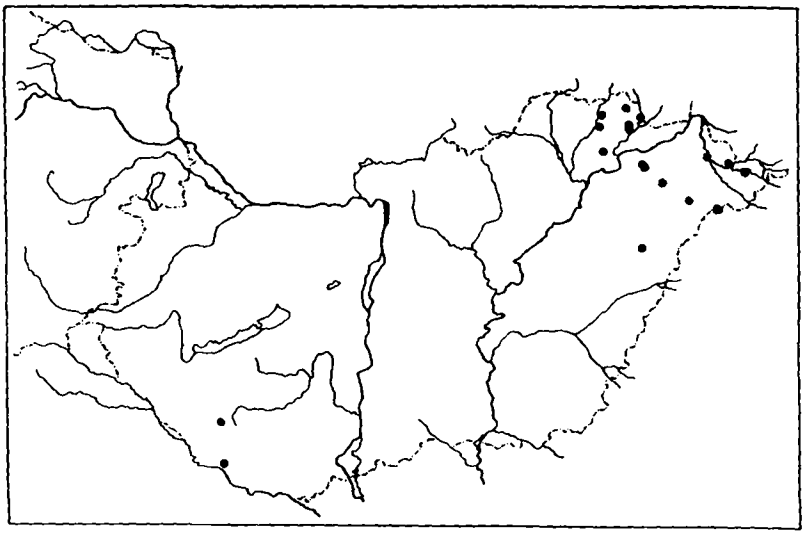

Fig. 16. Map of the distribution of *Cardamine majovskii* MARHOLD et ZÁBORSKÝ in Hungary.

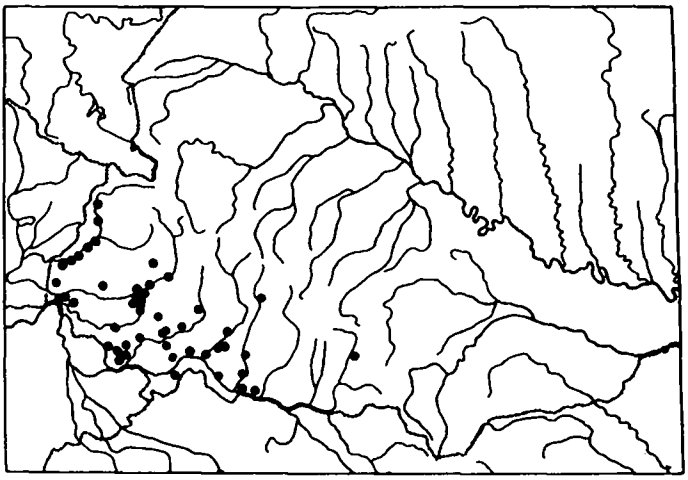

Fig. 17. Map of the distribution of *Cardamine majovskii* MARHOLD et ZÁBORSKÝ in the Carpathian and Pannonian part of Ukraine.

Exsiccata visa

Fl. Olten. Exs. no. 646 (ut *Cardamine pratensis* var. *grandiflora* NEILR.) (CL, KRAM, PRC, UPS, WU).

Icones

Icones nostrae : Fig. 14; MARHOLD et ZÁBORSKÝ Preslia 58: 194, fig. 1, 1986.

Taxonomic history

It is most likely that the only published name synonymous with *C. majovskii* is *C. hayneana* var. *iliciana* FRITSCH. In the description of this variety FRITSCH (1895) wrote "Flores ut in specie typica, sed majores". The lectotype of this variety corresponds well with the description of *C. majovskii*. Before any certain decision can be made as to the taxonomic position of this name chromosome numbers from the type locality should be ascertained.

Brief description

Perennial herb, 15-50 cm tall. Rhizome short, simple or rarely branched. Stem erect, branched at base and above, rarely simple, glabrous. Most of the immature rosette leaves with dense, rarely sparse, appressed hairs, old rosette leaves glabrous (or shrivelled at anthesis), pinnate, with (2-) 5-8 pairs of sessile or shortly petiolulate, ovate, obovate or oblanceolate, entire or crenate lateral leaflets; terminal leaflet much larger than lateral ones, 5-19 mm wide, reniform to cuneate at base, entire or crenate. Cauline leaves (2-) 3-10 (-14), glabrous, pinnatisect (the first and second lowermost leaves seldom pinnate), lower cauline leaves with (1-) 3-10 (-15) pairs of segments, the number of segments diminishing gradually up the stem,

segments linear to oblanceolate, entire, leaflets or segments of middle and lower cauline leaves horizontally spreading, basal leaflets or segments often slightly deflexed. Inflorescence racemose; sepals (3.0-) 3.3-5.4 (-5.7) mm long, margin membranous; petals white or pale reddish-violet, obovate, 8.5-16.5 mm long × (5.0-) 5.5-12.0 mm wide; stamens 6, anthers yellow before anthesis, filaments of longer stamens (4.0-) 4.7-7.3 (-7.8) mm long, filaments of shorter stamens (2.4-) 2.8-5.0 (-5.4) mm long; stigma conspicuous, enlarged. Range of means of pollen grain diameter calculated for one plant 28.37-32.31 μm. Pedicels patent or erect-patent, siliquae divergent from axis at the same angle as pedicels or erect, 18-46 mm long × 0.9-1.3 (-1.4) mm wide.

Flowering: April - May.

2n = **32**, 34

General distribution

Cardamine majovskii occurs in the eastern part of Pannonia, at low altitudes of the easternmost West Carpathians and in the East and South Carpathians.

Slovakia (Fig. 15):

Pannonicum. 8. Východoslovenská nížina. - **Carpaticum occidentale.** 19. Slanské vrchy, 20. Vihorlatské vrchy, 30a. Šarišská vrchovina [?], 30c. Nízke Beskydy. - **Carpaticum orientale.** 31. Bukovské vrchy.

Hungary (Fig. 16):

I. Matricum. 1. Tokajense. - **II. Eupannonicum.** 4. Crisicum, 5. Nyirsegense, 6. Samicum. - **V. Praeillyricum.** 2. Somogyicum.

Ukraine (Fig. 17):

Carpaticum orientale. II. Schidni Beskydy j Nyz'ki Polonyny, III. Gorgany, V. Čornohora, VIII. Vulkanični Karpaty, IX. Zakarpats'ke peredhir"ja. - **Pannonicum.** X. Zakarpats'ka rivnyna.

Romania:

Districts Harghita, Braşov, Sibiu, Mehedinţi, Timiş, Arad, Cluj, Giurgiu.

Maximum altitude: Ukraine, Gorgany Mts., Nehrovec state nature reserve, peat bog, 602 m, 1990, MARHOLD & KAHALO (SAV).

Ecology and phytosociology

Cardamine majovskii is found in flood-plain forests, on the banks of oxbow lakes, wet meadows, and pastures on slightly acid soils. It occurs in communities of the alliances *Alnion glutinosae* MALCUIT 1929, *Alno-Ulmion* BR.-BL. et R.TX. ex TSCHOU 1948 em. TH. MÜLLER et GÖRS 1958, *Salicion albae* (OBERD.1933) TH. MÜLLER et GÖRS 1958, and orders *Phragmitetalia* (KOCH 1926) PIGNATTI 1953, *Magnocaricetalia* PIGNATTI 1953, and *Arrhenatheretalia* PAWŁOWSKI in PAWŁOWSKI et al. 1928.

Cardamine dentata SCHULT.

Cardamine dentata SCHULT. Observ. Bot.: 126, 1809.

Ind. loc.: "Ad rivulos Galiciae". Typus ignotus.

BUSCH (1939) stated that the type of this name occurred in Krakow and a cotype in Stockholm. This statement, however, appears to be only an assumption, as no such specimens have been located in any of the herbaria of these cities. The name *C. dentata* SCHULT., adopted here for this taxon, is interpreted according to the original description (see below).

≡ *Cardamine pratensis* var. *dentata* (SCHULT.) WIMM. et GRAB. Fl. Siles. 2/1: 266, 1829.

≡ *Cardamine pratensis* subsp. *dentata* (SCHULT.) ČELAK. Prodr. Fl. Böhmen: 450, 1875.

= *Cardamine pratensis* var. *palustris* WIMM. et GRAB. Fl. Siles. 2/1: 266, 1829.

Ind. loc.: "Zwischen Liebenau und Riemberg". Typus ignotus.

≡ *Cardamine dentata* var. *palustris* (WIMM. et GRAB.) KHATRI Feddes Repert. 97: 281, 1986.

≡ *Cardamine pratensis* subsp. *palustris* (WIMM. et GRAB.) JANCH. Phyton 8: 236, 1959.

- *Cardamine pratensis* subsp. *palustris* (WIMM. et GRAB.) JANCH. Cat. Fl. Austr. 1/2: 218, 1957 (comb. invalid. - Art. 33.2).

= *Cardamine palustris* PETERM. Bot. Centralbl. Deutschl. 1: 47, 48, 11 Feb. 1846.

Ind. loc.: "Zschocher bei Leipzig". Lectotypus vel neotypus (**hoc loco designatus**): An sumpfigen Stellen unweit Zschocher bei Leipzig, s.a., PETERMANN (UPS).

= *Cardamine paludosa* KNAF Flora 29: 293, 21 May 1846.

Ind. loc.: "Auf Sumpfwiesen bei Jaromierz; bei St. Iwan (1827)". Lectotypus (**hoc loco designatus**): Ad Jaromierz Boh., 1841, KNAF (PRC).

≡ *Cardamine pratensis* subsp. *paludosa* (KNAF) ČELAK. Živa 4: 78, 1870.

= *Cardamine grandiflora* HALLIER Bot. Zeitung (Berlin) 24: 209, 1866.

Ind. loc.: "Am rechten Ufer der Saale oberhalb Jena's zwischen der Stadt und dem Dorfe Unter-Wöllnitz". Typus ignotus.

= *Cardamine fragmentosa* PÉNZES et VIDA Bot. Közlem. 53: 172, 1966. Ind. loc.: "Hungaria, comitatis [sic!] Pest, prope pagum Soroksár, ad latera rivuli". Typus ignotus.

- *Cardamine sylvatica* auct. non LINK: BESSER Prim. Fl. Galiciae Austriac. 2: 76, 1809.

Exsiccata visa

Fl. Exs. Austro-Hung. no. 1278 (BM, BP, BRA, CL, K, PRC, SIB, W, WU) - Fl. Exs. Reipubl. Bohem. Slov. no. 1027 (BRNU, CL, K, NI, OL, PR, PRC, W, WU, ZV);

Extra fines: Herb. Fl. Ingr. cent. 9, no. 47b (BM, CGE, OXF) - Herb. Fl. Ross. no. 1453 (PRC,WU) - Pl. Finl. Exs. no. 1952 (K, W, WU) - REHMAN & WOŁOSZCZAK Fl. Polon. Exs. no. 309 (BM, KRA, LW, W, WU), no. 309b (BM, CL, KRA, KRA, LW, W, WU) - SCHULTZ Herb. Norm. no. 1708 (BM, K, W) - TAUSCH Herb. Fl. Bohem. no. 122c (PRC).

Icones

LINDMAN Nord. Fl. 2: fig. 268b, 1964. - HEJNÝ & SLAVÍK Květ. ČR 3: 99, tab. 21, fig. 2, 1992. - JÁVORKA & CSAPODY Icon. Fl. Part. Austro-Orient. Eur. Centr.: 200, fig. 1522, 1975.

Icon nostra: Fig. 18.

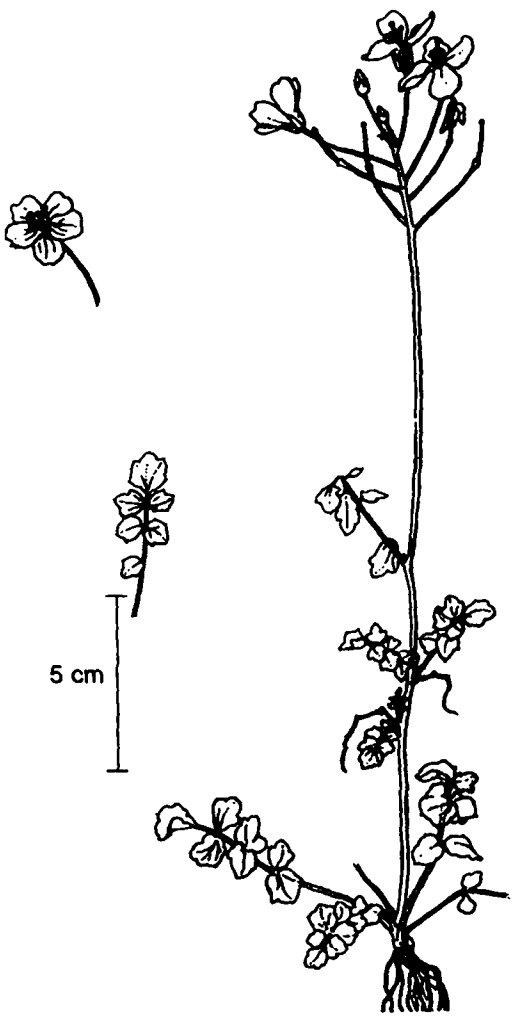

Fig. 18. *Cardamine dentata* SCHULT.

Taxonomic history

SCHULTES (1809) considered the presence of stolons, and cauline leaves with petiolulate and dentate leaflets as characters distinguishing *Cardamine dentata* from *C. pratensis*. Indeed the petiolulate leaflets of the cauline leaves are diagnostic of this species as used in recent literature, but the former character has caused many problems for later authors due to the fact that stolons are not present in any species of the *C. pratensis* group. This character, however, may be an understandable misinterpretation of structures; the habit of the leaves of the rosette, which sometimes root at the bases of leaflets, being mistaken for stolons. Later REICHENBACH (1830-1832, 1837-1838), KOCH (1835), NEILREICH (1859), and others misinterpreted this taxon. They placed under this name (or the name *C. pratensis* var. *dentata*) plants possessing rosette and basal cauline leaves with dentate leaflets, here considered as representing *C. pratensis* s. str. It was probably this incorrect interpretation of SCHULTES' species which caused this taxon to be described by various authors (KNAF 1846, PETERMANN 1846, HALLIER 1866) under different names. PETERMANN (1846) included in his *C. palustris* not only plants with leaflets of the stem leaves dentate (*C. palustris* var. *isophylla*), but also plants with entire leaflets (*C. palustris* var. *heterophylla*). Thus his concept of *C. palustris* was slightly broader than SCHULTES' *C. dentata*.

It is most likely that the first author to readopt SCHULTES' interpretation of *C. dentata* was ČELAKOVSKÝ (1872), who criticised the incorrect interpretation of this species by KOCH (1835). *Cardamine dentata* was also studied by LINDMANN (1914), who emended the description of this species in order to include plants with dentate as well as plants with entire leaflets of the stem leaves. LÖVKVIST (1956) considered the

name *C. dentata* as confusing and instead adopted as the correct name for this taxon *C. palustris* PETERM. He found that plants with 2n = 76 were identical with PETERMANN's variety *C. palustris* var. *isophylla*. LÖVKVIST (1956) showed from breeding experiments and field studies, however, that "no sterility barrier is met with between the octoploids and the decaploids, and [that] the morphological line from 56-chromosomic plants to 72- and 80-chromosomic ones makes it necessary to treat the whole octo- and decaploid (and dodecaploid) aggregate as one very wide species". The use of the name *C. palustris* by LÖVKVIST (1956) has influenced other authors including JONES (1964).

SOÓ & ISÉPY (1968) segregated populations, circumscribed here as *C. dentata*, into *C. pratensis* subsp. *dentata* (SCHULT.) ČELAK. and *C. pratensis* subsp. *paludosa* (KNAF) ČELAK., and KHATRI (1986) segregated them into *C. dentata* SCHULT. var. *dentata* and *C. dentata* var. *palustris* (WIMM. et GRAB.) KHATRI. These divisions, bearing in mind the results of LÖVKVIST (1956), do not appear to be justified.

Brief description

Perennial herb, (20-) 30-50 cm tall. Rhizome short, simple. Stem erect, usually simple, glabrous. Leaves pinnate. Rosette leaves mostly glabrous, immature leaves with appressed or rarely patent hairs, pinnate, with 3-12 pairs of petiolulate, circular to broadly ovate, rarely obovate, deciduous lateral leaflets; terminal leaflet much larger than lateral ones, reniform to truncate at base, entire or ± sinuate. Cauline leaves 5-12, glabrous, pinnate, lower cauline leaves with 3-10 pairs of leaflets, leaflets distinctly petiolulate, often deciduous, elliptic, obovate to linear, entire or irregularly serrate to sinuate. Inflorescence racemose; sepals 4.5-6.0 mm long, margin membranous; petals white to pale reddish-violet, obovate, (9.0-) 12.0-16.0 (-19.0) mm long × 7.0-11.0 mm wide; stamens 6, anthers yellow before anthesis, filaments of longer stamens 4.5-8.5 mm long, filaments of shorter stamens 2.5-5.5 mm long; stigma conspicuous, enlarged. Pedicels patent or erect-patent, siliquae divergent from axis at the same angle as pedicels or erect, (20-) 30-50 mm long × 1.1-1.5 (-2.0) mm wide.

Flowering: May.

2n = **64**, c. **80**

General distribution

Cardamine dentata occurs in central and north-western Europe, to the north of the River Po and the Danube Basin; it extends eastwards to Siberia, the Far East, the Kamčatka Peninsula and the Kuril Islands. It is also reported from North America.

Distribution in the Carpathians and Pannonia

Cardamine dentata occurs locally in Pannonia, particularly in the vicinity of major rivers. It is very rare in the Carpathians. There are no herbarium specimens of this species for Romania. The plants identified by NYÁRÁDY (1955) as varieties *C. pratensis* var. *palustris* WIMM. et GRAB. and *C. pratensis* var. *dentata* (SCHULT.) WIMM. et GRAB. and documented by herbarium specimens belong to *C. pratensis* or *C. matthioli* (Fl. Rom. Exs. no. 1705). The presence of *C. dentata* in Hungarian localities in the proximity of the Romanian border, however, suggests the possibility that this species occurs in north-west Romania.

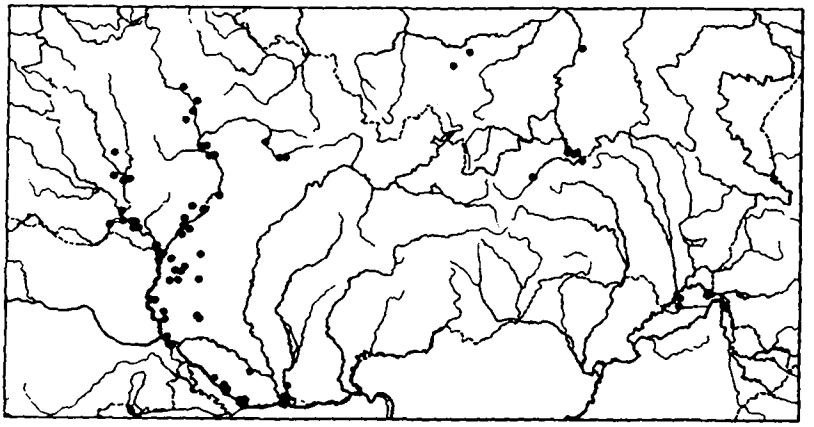

Fig. 19. Map of the distribution of *Cardamine dentata* SCHULT. in the Carpathian and Pannonian part of Poland and Moravia and in Slovakia (● - herbarium specimens, ○ - data from the literature).

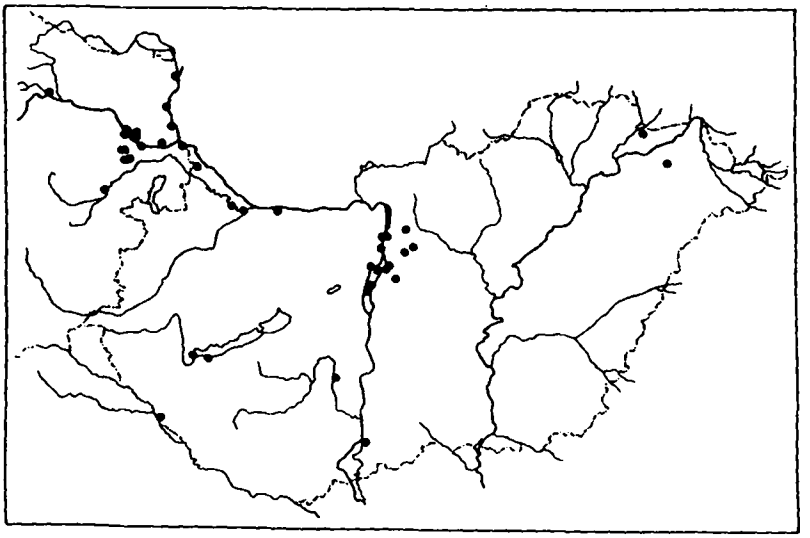

Fig. 20. Map of the distribution of *Cardamine dentata* SCHULT. in the Pannonian part of Austria and in Hungary.

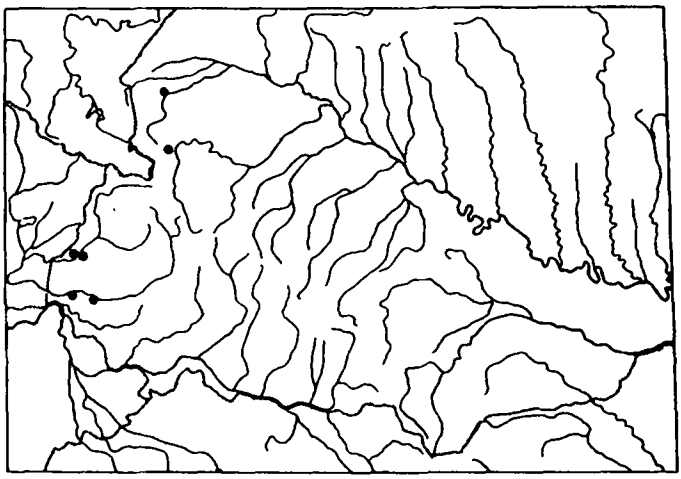

Fig. 21. Map of the distribution of *Cardamine dentata* SCHULT. in the Carpathian and Pannonian part of Ukraine.

Poland (Fig. 19)
Karpaty Zachodnie. 513.33. Pogórze Wielickie, 513.48. Beskid Makowski, 513.61. Pogórze Roznowskie.

Moravia (Fig. 19)
Pannonicum. 16. Znojemsko-brněnská pahorkatina, 18a. Dyjsko-svratecký úval, 18b. Dolnomoravský úval, 21a. Hanácká pahorkatina, 21b. Hornomoravský úval.
Mesophyticum carpaticum. 80a. Vsetínská kotlina.

Slovakia (Fig. 19)
Pannonicum. 4. Záhorská nížina, 6. Podunajská nížina, 8. Východoslovenská nížina .
Carpaticum occidentale. 10. Malé Karpaty, 26b. Spišské kotliny, 29. Spišské vrchy.

Austria (Fig. 20)
Several localities in the vicinity of the Rivers Donau, March and Leitha.

Hungary (Fig. 20)
I. Matricum. 5. Neogradense. - **IV. Eupannonicum.** 1. Arrabonicum, 2. Colocense, 3. Praematricum, 4. Crisicum, 6. Samicum . - **V. Praeillyricum.** 1. Saladiense, 2. Somogyicum.

Ukraine (Fig. 21)
Carpaticum orientale. I. Prykarpattja, II. Schidni Beskydy j Nyz'ki Polonyny. - **Pannonicum.** X. Zakarpats'ka rivnyna.

Maximum altitude: Ukraine, Schidni Beskydy j Nyz'ki Polonyny Mts, Turka, NE of the town, 650 m, 1990, MARHOLD & KAHALO (SAV).

Ecology and phytosociology

Cardamine dentata grows at the margins of standing water, in alder and flood-plain woods, and also rarely in wet meadows; in communities of the order *Magnocaricetalia* PIGNATTI 1953 and alliances *Alno-Ulmion* BR.-BL. et R.TX. ex TSCHOU 1948 em. TH. MÜLLER et GÖRS 1958 and *Alnion glutinosae* MALCUIT 1929.

Cardamine rivularis SCHUR

Cardamine rivularis SCHUR Verh. Mitth. Siebenbürg. Vereins Naturwiss. Hermannstadt 4: 61, 63, 1853.
Ind. loc.: "Arpáser Alpen" (SCHUR 1852: 84). Lectotypus (MARHOLD & RAYNER 1994): Arpasser Alpen an Gebirgsbächen, 27.VII.1850, SCHUR (W).
≡ *Cardamine pratensis* subsp. *rivularis* (SCHUR) NYMAN Consp. Fl. Eur.: 36, 1878.
≡ *Cardamine pratensis* "proles" *crassifolia* f. *rivularis* (SCHUR) O.E. SCHULZ Bot. Jahrb. Syst. 32: 533, 1903.
≡ *Cardamine pratensis* subsp. *hayneana* var. *rivularis* (SCHUR) NYÁR. in SĂVUL. Fl. Reip. Pop. Roman. 3: 270, 1955.

- *Cardamine pratensis* subsp. *rivularis* (SCHUR) JANCH. Cat. Fl. Austr. 1/2: 218, 1957 (comb. superfl.).

- *Cardamine pratensis* subsp. *rivularis* (SCHUR) BOLÒS et VIGO Butl. Inst. Catalana Hist. Nat. 38:75, 1974 (comb. superfl.).

= *Cardamine pratensis* var. *alpicola* ANDRAE Bot. Zeitung (Berlin) 11: 414, 1853.
Ind. loc.: sine. The original material of this variety was, according to SCHULZ (1903: 533), deposited in B, where it was apparently destroyed during World War II.

= *Cardamine pratensis* var. *subalpina* HEUFF. Verh. K. K. Zool.-Bot. Ges. Wien 8:53, 1858.
Ind. loc.: "In uligine ad crucem alpe Szarko". Typus ignotus.

= *Cardamine amethystea* PANČIĆ Nova Elem. Fl. Bulg.: 15, 1886. Ind. loc.: "In pascuis excelsioribus m. Rilo non procul a via qua itur ad urbe Samokov ad coenobium Rilo, paulo infra limitem, quo aquae rivum Rilo petentes ab aliis Iskrae tributariis dirimuntur". Lectotypus (**hoc loco designatus**): In herbidis excelsioribus m. Rilo, VII.1883, PANČIĆ (G-BOIS).

Exsiccata visa

Pl. Transsylv. Herb. SCHOTT no. 398 (K,WU).

Icones

ASSENOV in JORDANOV Fl. Reip. Pop. Bulg. 4: 435, tab. 79, fig. 2, 1970. - NYÁRÁDY in SĂVULESCU Fl. Reip. Pop. Roman. 3: 261, tab. 45, fig. 4, 1955.
Icon nostra : Fig. 22.

Taxonomic history

In SCHUR's protologue (1853: 61, 63) of *Cardamine rivularis*, published in the fifth part of his Flora von Siebenbürgen, he did not designate any particular specimen as the type,

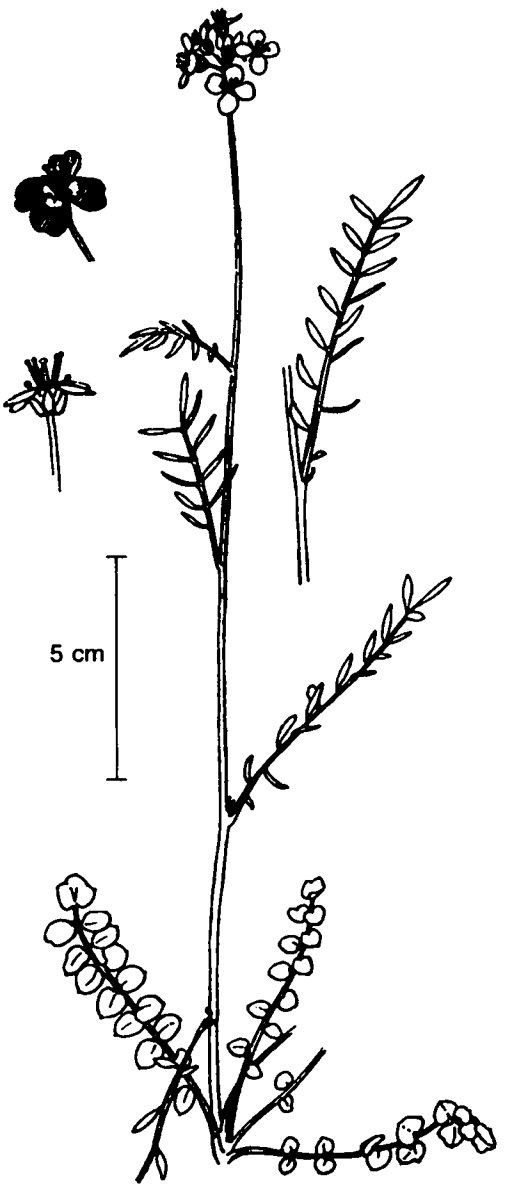

Fig. 22. *Cardamine rivularis* SCHUR (detail of flower enlarged).

however, a lectotype was selected recently (MARHOLD & RAYNER 1994). In his validating description SCHUR stressed, among other characters, the "antheris violaceis". Material of this taxon collected by SCHUR is deposited in six herbaria (GOET, L, LW, M, S and W), but as these specimens are poorly preserved it is not possible to determine the colour of the anthers. This fact has led several authors (LINDMANN 1914, LÖVKVIST 1956, URBANSKA-WORYTKIEWICZ & LANDOLT 1974) to doubt the accuracy of SCHUR's description. The study of living plants in the type locality in the vicinity of Vf. Arpaş and other localities in the Mţii Făgăraşului, shows that SCHUR's description is correct. The purplish colour of anthers before anthesis is one of the most important morphological characters for the delimitation of this species.

In his work, Enumeratio plantarum Transsilvaniae, SCHUR (1866) noted the occurrence of *C. rivularis* from Mt. "Königstein" near Braşov, the Mţii Bucegi, and from Vf. Ineu ("Kühhorn") in the Mţii Rodnei in addition to the type locality. The examination of a large amount of material from all these localities, however, shows that this taxon is absent from Vf. Ineu as well as from elsewhere in the East Carpathians. All specimens collected at this locality belong to "*rivularis* auct."

KERNER (1883) included in *Cardamine rivularis* populations of the *C. pratensis* group from the subalpine belt of the Eastern Alps. He stated that plants of this group from Mt. Stubalpe (Styria) are identical with the original material from the Mţii Făgăraşului and SCHUR's description of *C. rivularis*. He did not comment on the difference in colour of the anthers nor did he notice the difference in the hairs on the basal leaves between these plants.

SCHULZ (1903) published *C. pratensis* "proles" *crassifolia* (POURR.) O.E. SCHULZ in which he included populations from St. Paul Island in the Bering Sea and the high mountain populations from the Pyrenees, the Alps, the East and South Carpathians, Bulgarian mountains, and the Altai. Such a broad taxon, however, cannot be maintained. *C. crassifolia* POURR. is endemic to the Pyrenees and characterised by an ascending stem. Plants from the Altai and St. Paul Island most probably belong to other taxa of the *C. pratensis* group. Within *C. pratensis* "proles" *crassifolia* SCHULZ (1903) distinguished plants from the South Carpathians and Bulgaria possessing violet anthers as forma *rivularis* (SCHUR) O.E. SCHULZ. The difference between high mountain populations of the *Cardamine pratensis* group from the South Carpathians and Bulgaria (with purplish anthers) and those from the East Carpathians (with yellow anthers) were formally recognized also by JÁVORKA (1924). He classified the former as *C. pratensis* * *rivularis* (SCHUR) and the latter as *C. pratensis* * *crassifolia* (POURR.) O.E. SCHULZ without mentioning any rank for these taxa.

The morphological variability within the mountain populations of the *Cardamine pratensis* group in the Alps, Appenines, Massif Central, Carpathians and Bulgaria was not formally recognized by later authors. LÖVKVIST (1956), URBANSKA-WORYTKIEWICZ & LANDOLT (1974), LANDOLT (1984), and JONES (1964) followed the broad concept of *C. rivularis* as proposed by KERNER (1883).

Brief description

Perennial herb, 12-30 (-45) cm tall. Rhizome short, mostly simple. Stem erect, simple, rarely branched, glabrous. Most of the young rosette leaves with dense or rarely sparse appressed hairs, old rosette leaves mostly glabrous, pinnate, with 5-11 pairs of petiolulate, circular to circular-ovate, entire or sharply crenate lateral leaflets; terminal leaflet approximately the same size as lateral ones, reniform to circular, entire or sharply crenate, 3-10 (-13) mm wide. Cauline leaves (3-) 4-12, pinnatisect (the first and second lowermost leaves seldom pinnate, the same as rosette leaves), glabrous, lower cauline leaves with 2-14 pairs of segments or leaflets, the number of segments diminishing gradually up the stem, segments linear to oblanceolate, mostly entire, slightly ascending. Inflorescence racemose; sepals 2.5-4.0 mm long, margin membranous; petals purple, obovate, 6.5-10.5 mm long × 3.0-6.5 mm wide; stamens 6, anthers purplish before dehiscence, filaments of longer stamens 3.5-7.5 mm long, filaments of shorter stamens 2.5-5.5 mm long; stigma conspicuous. Pedicels patent or erect-patent, siliquae divergent from axis at the same angle as pedicels or erect, 15.0-25.0 mm long × 1.5-2.0 (-2.5) mm wide.

Flowering : July - August.

2n = **16**, 24

General distribution

Cardamine rivularis occurs mainly in the subalpine and alpine belts of the South Carpathians and Bulgarian mountains (Mt. Vitoša and the Rila, Rodopi, and Pirin Mts).

Romania:

Districts Harghita, Buzău, Prahova, Dimboviţa, Braşov, Argeş, Sibiu, Vilcea, Gorj, Hunedoara (in the mountains of Giurgeului, Vrancei, Bucegi, Bîrsei, Ţaga, Făgăraşului, Cindrel, Lotrului, Şureanu, and Parîngului).

Minimum altitude: Romania, district Braşov, Mţii Bîrsei, Malojeşt, 1000 m, 1912, PAX (BP). Maximum altitude: Romania, district Dimboviţa/Prahova, Mţii Bucegi, Valea Iepilor, 2100 m, 1955, PÓCS (BP); Romania, district Sibiu, Mţii Făgăraşului, Bîlea Lac, 2034 m, 1989, MARHOLD (SAV).

Ecology and phytosociology

Cardamine rivularis occurs in communities of spring vegetation, on stream banks and in other wet places, in the subalpine and alpine belts. BELDIE (1967) records this taxon for the *Blysmus compressus-Juncus articulatus* and *Cratoneuron commutatum-Bryum pseudotriquetrum* communities and PUŞCARU et al. (1956) from the communities with *Blysmus compressus* and *Cratoneuron commutatum* (all probably of the order *Montio-Cardaminetalia* PAWŁOWSKI in PAWŁOWSKI et al. 1928). PUŞCARU et al. (1956) noted *C. rivularis* also for the *Sphagnetum acutifolii* community (most probably of the order *Caricetalia fuscae* KOCH 1926 em. NORDHAGEN 1937).

Acknowledgments: I would like to thank the directors and curators of the herbaria who allowed me to study material, and to Prof. M. A. Fischer, Dr W. Gutermann, Dr E. Hörandl, Mr J. Hadinec, Prof. A. Jasiewicz and Prof. J. Mądalski who kindly loaned personal herbaria. I am also grateful to Drs C. Drăgulescu, A. Kahalo, J.J. Wójcicki, and M. Zagulskij for their help in the field, to Doc. Dr V. Feráková, CSc. for valuable comments, and to Mrs K. Cigánová for providing the illustrations of the plants. This work was supported by the Grant Agency for Science, Bratislava, Slovakia (Grant No. 2/41/92) and by the Ministry for Science and Research, Vienna, Austria, through the East-West Programm of the Austrian Academy of Sciences (Project No. OWP 58), which is gratefully acknowledged.

REFERENCES

AL-SHEHBAZ I. A. (1988): The genera of *Arabideae* (*Cruciferae*, *Brassicaceae*) in the Southeastern United States. - J. Arnold Arbor. 69: 85-166.

BELDIE A. (1967): Flora şi vegetatia muntilor Bucegi (Flora and vegetation of the Bucegi Mts). - Editura Academiei RSR, Bucureşti.

BUSCH N.A. (1939): Rod 591. Serdečnik - *Cardamine* L. - In: KOMAROV V.L. [ed.]: Flora SSSR 8 (Flora of the USSR), Moskva & Leningrad, pp. 153-170.

ČELAKOVSKÝ L. (1872): Bemerkungen über Cruciferen. - Flora 55: 433-446.

ČOPYK V.I. [ed.] (1977): Vyznačnyk roslyn Ukrajinskych Karpat (Identification key to the plants of the Ukrainian Carpathians). - Naukova Dumka, Kyjiv.

COLDEA G. (1990): Munţii Rodnei. Studiu geobotanic (Rodnei Mts. Geobotanical study). - Editura Academiei Române, Bucureşti.

FRITSCH C. (1895): Beiträge zur Flora der Balkanhalbinsel mit besonderer Berücksichtigung von Serbien 2. - Verh. K.K. Zool.-Bot. Ges. Wien 44: 301-327.

FUTÁK J. (1980): Fytogeografické členenie (Phytogeographical division). - In: MAZÚR E. [ed.]: Atlas Slovenskej socialistickej republiky (Atlas of the Slovak Socialist Republic), Veda VSAV, Bratislava.

GREUTER W., BURDET H. M., CHALONER W. G., DEMOULIN V., GROLLE R., HAWKSWORTH D. L., VOSS E. G. & MCNEILL J. [eds.] (1988): International code of botanical nomenclature adopted by the Fourteenth International Botanical Congress, Berlin, July-August 1987. - Regnum Veg. 118.

HALLIER F. (1866): Ueber ein neues Schaumkraut in den Sachsen-Sümpfen bei Jena. - Bot. Zeitung (Berlin) 24: 209, 210.

HOLMGREN P.K., HOLMGREN N.H. & BARNETT L.C. (1990): Index Herbariorum. Part. I: The herbaria of the world. Ed. 8. - New York Botanical Garden, Bronx.

JÁVORKA S. (1924): XXXII. *Cardamine* L. - Foszlár. Kakuktorma. - In: JÁVORKA S. [ed.]: Magyar Flóra (Hungarian Flora), Budapest, pp. 422-425.

JONES B.M.G. (1964): 41. *Cardamine* L. - In: TUTIN T.G. et al. [eds.]: Flora Europaea, Ed. 1, Vol. 1, Cambridge University Press, Cambridge, pp. 285-289.

KERNER A. (1883): Schedae ad Floram exsiccatam Austro-Hungaricam. No. 889. - Vindobonae.

KHATRI K.S. (1986): Application of the names *Cardamine acris*, *C. dentata*, *C. scutata* and *C. trifida*. - Feddes Repert. 97: 279-283.

KHATRI K.S. (1989): *Cardamine* L. sect. *Cardamine* (*Cruciferae*) in the Asian territory of Soviet Union. - Feddes Repert. 100: 81-96.

KNAF J. (1846): Exiguitates botanicae. - Flora 29: 289-300.

KOCH W.D.J. (1835): Synopsis florae germanicae et helveticae 1. - Francofurti ad Moenum.

KONDRACKI J. (1981): Geografia fizyczna Polski. Ed. 4 (Physical geography of Poland). - Państwowe wydawnictwo naukowe, Warszawa.

LANDOLT E. (1984): Über die Artengruppe der *Cardamine pratensis* L. in der Schweiz. - Diss. Bot. 72: 481-497.

LINDMANN C.A.M. (1914): *Cardamine pratensis* L. und *C. dentata* SCHULTES (emend.). - Bot. Not. 1914: 267-286.

LÖVKVIST B. (1956): The *Cardamine pratensis* complex. Outline of its cytogenetics and taxonomy. - Symb. Bot. Upsal. 14/2: 1-131.

MARHOLD K. (1991): Critical notes to *Cardamine pratensis* agg. in NE Hungary. - Acta Bot. Hung. 35(1989): 279-285.

MARHOLD K. (1992): A multivariate morphometric study of the *Cardamine amara* group (*Cruciferae*) in the Carpathian and Sudeten mountains. - Bot. J. Linn. Soc. 110: 121-135.

MARHOLD K. (1993): 15. *Cardamine pratensis* L. - In: TUTIN T.G. et al. [eds.]: Flora Europaea, Ed. 2, Vol. 1, Cambridge University Press, Cambridge, pp. 349-350.

MARHOLD K. (1994a): Chromosome numbers of the genus *Cardamine* L. (*Cruciferae*) in the Carpathians and in Pannonia. - Phyton (Horn) 34: 19-34.

MARHOLD K. (1994b): Multivariate morphometric study of the *Cardamine pratensis* group (*Cruciferae*) in the Carpathian and Pannonian area. - Pl. Syst. Evol. (in press).

MARHOLD K. & RAYNER T. G. J. (1994): Typification of the names of two species of the *Cardamine pratensis* group (*Brassicaceae*). - Taxon 43: 77-83.

MORETTI G. (1847a): Difesa e illustrazione delle opere botaniche di Pier Andrea Mattioli botanico del XVI secolo, memoria 5 (Defence and illustrations of the botanical work of Pier Andrea Matthioli, botanist of the XVI century, part 5). - Milan.

MORETTI G. (1847b): Difesa e illustrazione delle opere botaniche di Pier Andrea Mattioli botanico del XVI secolo, memoria 5 (Defence and illustrations of the botanical work of Pier Andrea Matthioli, botanist of the XVI century, part 5). - Giorn. Imp. Reale Ist. Lombardo Sci. 8: 605-624.

MORETTI G. (1847c): Difesa e illustrazione delle opere botaniche di Pier Andrea Mattioli botanico del XVI secolo, memoria 5 (Defence and illustrations of the botanical work of Pier Andrea Matthioli, botanist of the XVI century, part 5). - Giorn. Imp. Reale Ist. Lombardo Sci. & Bibliot. Ital. 16: 341-360.

NEILREICH A. (1859): Flora von Nieder-Oesterreich. - Wien.

NIKLFELD H. (1964): Zur xerothermen Vegetation in Osten Nieder-Österreich. - Verh. Zool.-Bot. Ges. Wien 103-104: 152-181.

NOVÁK F.A. (1948): Rod 125. *Cardamine* L. em. CR. - Řeřišnice - Žerušnica. - In: DOSTÁL J. [ed.]: Květena ČSR (Flora of the Czechoslovak Republic), Přírodovědecké nakladatelství, Praha, pp. 286-293.

NYÁRÁDY E.I. (1955): Genul 157. *Cardamine* L. - In: SĂVULESCU T. [ed.]: Flora republicii populare Romîne 3 (Flora of the Romanian People's Republic 3), Editura Academiei RPR, Bucureşti, pp. 255-275.

PETERMANN W.L. (1846): Ueber zwei neue Species der deutschen Flora. - Bot. Centralbl. Deutschl. 1: 45-48.

PUŞCARU D., PUŞCARU-SOROCEANU E., PAUCĂ A., ŞERBĂNESCU I., BELDIE A., ŞTEFUREAC T., CERNESCU N., SAGIN F., CRETU V., LUPAN L. & TAŞCENCO V. (1956): Păsunile alpine din munţii Bucegi (Alpine pastures of the Bucegi Mts). - Editura Academie RPR, Bucureşti.

REICHENBACH H.G.L. (1830-1832): Flora germanica excursoria. - Lipsiae.

REICHENBACH H.G.L. (1837-1838): Deutschlands Flora, 1. - Leipzig.

SCHULTES J.A. (1809): Observationes botanicae. - Oeniponti.

SCHULZ O.E. (1903): Monographie der Gattung *Cardamine*. - Bot. Jahrb. Syst. 32: 280-623.

SCHUR F. (1852): Beiträge zur Kenntniss der Flora von Siebenbürgen. II. Uebersicht der auf den Arpáser Alpen Ende July 1849 und 50 gesammelten und beobachteten Pflanzen. - Verh. Mitth. Siebenbürg. Vereins Naturwiss. Hermannstadt 3: 84-93.

SCHUR F. (1853): Beiträge zur Kenntniss der Flora von Siebenbürgen. V. Erläuterungen und Bemerkungen über die im Sertum Florae Transsilvaniae verzeichneten siebenbürgischen Pflanzen. V. *Cruciferae*. - Verh. Mitth. Siebenbürg. Vereins Naturwiss. Hermannstadt 4: 57-68.

SCHUR F. (1866): Enumeratio plantarum Transsilvaniae. - Vindobonae.

SCHUR F. (1877): Phytographische Mittheilungen über Pflanzenformen aus verschiedenen Florengebieten des Oesterreichischen Kaiserstaates. - Verh. Naturf. Vereins Brünn 15(1876): 3-200.

SKALICKÝ V. (1988): Regionálně fytogeografické členění (Regional phytogeographical division). - In: HEJNÝ S. & SLAVÍK B. [eds]: Květena České socialistické republiky 1 (Flora of the Czech Socialist Republic 1), Academia, Praha, pp. 103-121.

SOÓ R. (1964): A magyar flóra és vegetáció rendszertani - növényföldrajzi kézikönyve, 1 (Systematic and geobotanical synopsis of the Hungarian flora and vegetation, 1). - Akadémiai Kiadó, Budapest.

SOÓ R. & ISÉPY I. (1968): Über einige Formenkreise der ungarischen und karpatischen Flora. - Acta Bot. Acad. Sci. Hung. 14: 395-401.

TOMŠOVIC P. (1986): Two new taxa in the *Cardamine pratensis* agg. from Bohemia and Moravia (Czechoslovakia). - Folia Geobot. Phytotax. 21: 429-430.

URBANSKA-WORYTKIEWICZ K. & LANDOLT E. (1974): Biosystematic investigations in *Cardamine pratensis* L. s.l. I. Diploid taxa from Central Europe and their fertility relationships. - Ber. Geobot. Inst. ETH Stiftung Rübel 42: 42-139.

ZAPAŁOWICZ H. (1889): Roślinna szata gór Pokucko-Marmaroskich (Plant cover of the Pokucko-Marmaroskie Mts). - Spraw. Komis. Fizyjogr. 24: 1-389.

Received 20 October 1993, accepted 29 March 1994

Appendix

APPENDIX

Selected specimens
(for numbers and names of phytogeographic districts see "Distribution")

***Cardamine pratensis* L.**

Poland
Karpaty Zachodnie. 513.33. Przytkowice (1957 JASIEWICZ hb. JAS KRAM). - 513.34. Lipnica Murowana, Paporotna (1956 JASIEWICZ KRAM).- 513.45. Brenna (1968 BRODA KRA).- 513.46. Moszczanica (1878 KRUPA KRAM). - 513.47. Ponikiewka (1943 PELC KRAM). - 513.48. Kalwaria Zebrzydowska, Góra Klasztorna (1965 BARADZIEJ KRA). - 513.49. Zaryte (1967 DZWONKO KRA). - 513.51. Racza Hala (s.a. KRUPA KRAM). - 513.52. Rdzawka II., Kulakowy Wierch (1988, 1989 MARHOLD SAV). - 513.53. Nowy Sącz - Stary Sącz (1936 SŁOWIKOWSKI KRA). - 513.62. Lipnica Dolna (1960 WIŚNIEWICZ KRA). - 513.66. Biecz, Krolewska studnia (1870 KOTOWICZ KRAM). - 513.69. Targowiska (1923 PIECH KRAM). - 513.71. Grybów, Strzylawki (1988 STASZKIEWICZ SAV). - 514.11. Lasek, dolina Lepietnicy (1965 M. & J. GUZIKOWIE KRAM). - 514.12. Czorstyn, Snożka (1965 STENGL KRA). - 514.13. Mietłówka (1955 CHRONOWSKA KRA). - 514.14. Kościelisko, Młaka pod Kreptówkami (1882 KRUPA KRAM). - 514.52. Tatry, Zakopane (s.a. HERBICH LW). - **Beskidy Wschodnie.** 522.12. Cisna - Wetlina (1925 PIECH KRAM).

Moravia
Pannonicum. 16. Hnanice (1949 ŠVESTKA BRNU). - 18a. Brno, Černovice (1906 LAUS BRNU). - 18b. Mikulčice, Skařina (1948 STANĚK BRNM). - 19. Radějov SE (1985 GRULICH MMI). - 20a. Roštín (1981 SUTORÝ BRNM). - 20b. Brno, Tvarožná (1921 PODPĚRA BRNU). - 21a. Vyškov (1941 SKŘIVÁNEK PRC). - 21b. Kroměříž, Strž (1935 ZAVŘEL PR). - **Mesophyticum carpaticum.** 76a. Bystřice pod Hostýnem, Lipová (1941 ZAVŘEL PRC). - 77a. Nížkovice (1977 TLUSTÁK LIM). - 77c. Staré Hutě, u Kyjovky (1985 BARUŠOVÁ BRNU). - 78. Radějov, Kútky (1987 HLOBILOVÁ SAV). - 79. Vlachovice (1956 STANĚK BRNM). - 80a. Vsetín, Semetín (1924 ŘÍČAN BRNU). - 81. Držková (1972 VYSTAVĚLOVÁ BRNU). - 82. Francova Lhota (1943 STANĚK BRNU). - 83. Polanka nad Odrou, Polanský les (1955 POSPÍŠIL BRNU). - 84a. Čeladná, Stolová (1940 STANĚK BRNM). - **Oreophyticum carpaticum.** 99a. Horní Paseky (1954 STANĚK BRNM).

Slovakia
Pannonicum. 2. Polesie Lučenec (1961 RANDUŠKA ZV). - 3. Silická planina (1947 FUTÁK SLO). - 4. Malé Leváre (1990 FERÁKOVÁ SAV). - 5. Bratislava, Mlynská dolina (1883 MERGL SAV). - 6. Pastúchy (1986 GRULICH MMI). - **Carpaticum occidentale.** 10. Dobrá Voda (1989 VESELÁ & SUCHÁ SAV). - 11. Nová Lehota, Lehocká dolina (1950 STANĚK BRNM). - 12. Jelenec, Remitáž (1957 OSVAČILOVÁ NI). - 13. Horné Motešice (1879 FLEISCHER LW). - 14a. Žarnovica, near the railway station Voznica (1987 MARHOLD SAV). - 14b. Veľké Pole (1882 KMEŤ BRA). - 14c. Kremnica, Peklo (1987 MARHOLD SAV). - 14d. Ľubietová, dvor Čeljenec, Vepor (1973 ZAHRADNÍKOVÁ SAV). - 15. Hriňová, Biele Vody (1987 MARHOLD SAV). - 16. Muráň NE (1987 KOCHJAROVÁ SAV). - 21a. Kláštor pod Znievom (1890 WAGNER SZG). - 21b. Medziholie (1974 HUBOVÁ SAV). - 21c. Horný Harmanec, Rakytová skala (1955 STANĚK BRNM). - 22. Korytnica (s.a. REHMAN LW). - 23a. Juráňova dolina (1926 J. DOSTÁL PRC). - 23b. Zelené pleso (1830 HERBICH LW). - 23c. Tatranská Kotlina, Šarpanec (1911 E. I. NYÁRÁDY SIB). - 24. Prielom Dunajca (1892 ULLEPITSCH BP). - 25. Budiš (1985 ŠÍPOŠOVÁ SAV). - 26a. Východná (1987 KOCHJAROVÁ & HROUDA SAV). - 26b. Tatranská Štrba - Kolombiarok (1986 MARHOLD & HROUDA SAV). - 27b. Zárieč, Keblov (1975 MIČIETA SLO). - 28. Oravská Lesná, Magurka (1964 CHRTEK & ŽERTOVÁ PRC). - 29. Červený Kláštor (1889 ULLEPITSCH W). - 30a. Solivar (1914 VAJDA BP). - 30b. Bardejov, kúpele (1922 BERGANSKÝ BRA). - 30c. Nižná Polianka, W (1987 MARHOLD SAV). - **Carpaticum orientale.** 31. Ruské (1986 HADAČ PRC).

Austria
Wachau, Jauerling, Thalham (1915 RONNIGER W). - Wien, Stadlau (1934 J. SCHNEIDER W). - Fischamend (1923 SCHEFFER SLO). - Stopfenreuth (1985 GUTERMANN WU-G). - Moosbrunn (1922 SCHEFFER SLO).

Hungary
I. Matricum. 5. Királyháza, Kemence patak (1957 BOROS BP). - **II. Bakonyicum.** 3. Vertésszőlős (1942 BOROS BP). - **III. Praenoricum.** 2. Sorkiújfalud (s.a. MÁRTON BP). - **IV. Eupannonicum.** 1. Rajka, Dunakiliti (1920 BOROS BP). - 3. Budapest, Zugló (1930 VAJDA BP). - **V. Praeillyricum.** 2. Szenta, Szentai erdő (1923 BOROS BP).

Ukraine
Carpaticum orientale. I. Oblasť L'vivs'ka, Rajon Starosambirs'kyj, Busovys'ko (1988 MARHOLD & KAHALO SAV). - II. Oblasť L'vivs'ka, Rajon Turkivs'kyj, Turka NE (1990 MARHOLD & KAHALO SAV). - III. Oblasť Zakarpats'ka, Rajon Mižhirs'kyj, Synevyrs'ka Poljana (1990 MARHOLD & KAHALO SAV). - IV. Oblasť Zakarpats'ka, Rajon Rachivs'kyj, Bukovynka (1930 DEYL PRC). - V. Oblasť Zakarpats'ka, Rajon Rachivs'kyj, Polonyna Šumneska (1954 MALYNOVS'KYJ LWS). - VI. Oblasť Ivano-Frankivs'ka, Rajon Verchovyns'kyj, Burkut, near the Čorny Čeremoš River (1987 KARDAŠ, ZAGUL'SKYJ & PROKOPIV LW). - VIII. Oblasť Zakarpats'ka, Rajon Perečyns'kyj, Voročeve (1972 DYLAK UU).

Romania
Distr. Bistriţa-Năsăud. Valea Vinului (1941 E. I. NYÁRÁDY CL). - **Distr. Mureş.** Băile Sovata, "Zöldtó" (1944 E. I. NYÁRÁDY SIB). - **Distr. Harghita.** Topliţa (1942 SOÓ CL). - **Distr. Sibiu.** Cisnădie, "Bäresbach" (1831 SCHUR LW). - **Distr. Hunedoara.** Petroşani, Valea "Zsiec" (s.a. KNAPP CL). - **Distr. Alba.** Coltesti, Rîtul Dogarilor (1956 GERGELY CL). - **Distr. Arad.** Mţii Codru-Moma, Vf. Moma (s.a. SCHUR LW). - **Distr. Cluj.** Cluj-Napoca (s.a. KNAPP CL).

Cardamine pratensis, "*rivularis* auct."

Ukraine
Carpaticum orientale. - III. Oblasť Ivano-Frankivs'ka, Rajon Nadvirjans'kyj, Bratkovs'ka Mala (1939 ŚRODOŃ KRAM). - IV. Oblasť Zakarpats'ka, Rajon Rachivs'kyj, Apšinec' (1960 FODOR UU). - V. Oblasť Zakarpats'ka, Rajon Rachivs'kyj, Kvasovs'kyj Menčul (1934 BOROS BP). - VI. Oblasť Ivano-Franskivs'ka, Rajon Verchovins'kyj, Polonyna Čyvčynaž (1959 BRADIS & ANDRIENKO KW). - VII. Oblasť Zakarpats'ka, Rajon Rachivs'kyj, Berlebaška (1933 DEYL PR).

Romania
Distr. Maramureş. Borşa, Vf. Repede (1935 STANĚK BRNM). - **Distr. Bistriţa-Năsăud.** Mţii Rodnei, Vf. Ineu (1860 HAYNALD CL). - **Distr. Braşov.** Braşov, "Schulerberg" (1854 SCHUR LW). - **Distr. Bihor.** Mţii Bihorului, Valea Csepilor (1882 SIMKOVICS BP). - **Distr. Cluj.** Mţii Muntele Mare, La Tine (1917 GYÖRFFY, PÉTERFI & BOGSCH CL).

Cardamine pratensis, "*ucranica*"

Ukraine
Carpaticum orientale. I. Oblasť L'vivs'ka, Rajon Stryjs'kyj, Dovholuka - Ulyčne (1988, 1990 MARHOLD & KAHALO SAV). - II. Oblasť L'vivs'ka, Rajon Skolivs'kyj, Kozeve (1990 MARHOLD & KAHALO SAV). - III. Oblasť Ivano-Frankivs'ka, Rajon Dolyns'kyj, Ljudvykivka (1990 MARHOLD & KAHALO SAV).

***Cardamine matthioli* MORETTI**

Moravia

Pannonicum. 16. Brno, Jundrov - Žabovřesky (1981 ŘEPKA BRNM). - 18a. Rajhradský luh (1878 BECK PRC). - 18b. Mikulčice (1948 STANĚK BRNM). - 19. Velká nad Veličkou (1914 BÉŇA BRNU). - 20b. Slavkov u Brna (1978 ŘEPKA BRNM). - 21b. Kvítkovice (1956 STANĚK BRNM). - **Mesophyticum carpaticum.** 77c. Koryčany, Moravanské lúky (1950 STANĚK BRNM). 78. Radějov, Kútky (1985 GRULICH MMI).

Slovakia

Pannonicum. 1. Kamenica nad Hronom (1934 KRIST BRNU). - 2. Horšianska dolina (1974 JASENÁK LTM). - 3. Silická ľadnica (1987 FERÁKOVÁ & KOCHJAROVÁ SAV). - 4. Stupava (1946 STANĚK BRNM). - 5. Devínska Kobyla (1982 ZÁBORSKÝ SLO). - 6. Komárno, Lándor (1989 GRULICH MMI). - 7. Buzica (1968 VOJTUN KO). - 8. Hliviština - Baškovce (1989 MARHOLD SAV). - **Carpaticum occidentale.** 9. Skalica, Zlatnícka dolina (1927 SILLINGER PRC). - 10. Pezinok, Trnianska dolina (1986 MARHOLD SAV). - 11. Mníchova Lehota (1935 SCHIDLAY BRA). - 12. Skýcov (1988 ŠÍPOŠOVÁ & PENIAŠTEKOVÁ SAV). - 13. Trenčianske Mitice (1946 SCHIDLAY BRA). - 14a. Tekovské Nemce (1933 KLÁŠTERSKÝ & DEYL PR). - 14b. Veľké Pole (1882 KMEŤ BRA). - 14c. Kremnica, Krahulský štôs (1987 MARHOLD SAV). - 14d. Vígľaš, Pstruša (1985 MARHOLD SAV). - 14e. Čajkov, dolina Bukovinka (1974 JASENÁK LTM). - 14f. Krupina, N (1970 ZAHRADNÍKOVÁ, JASIČOVÁ & HUBOVÁ SAV). - 15. Čierny Balog, U Medveďov (1987 MARHOLD SAV). - 16. Tisovec, dolina Furmanec (1901 RICHTER CL). - 18. Košice, pod Bankovom (1933 BRYM PRC). - 19. Slanská Huta (1987 MARHOLD SAV). - 20. Jovsa, Sokolský potok (1950 STANĚK BRNM). - 21a. Kláštor pod Znievom (1910 NÓGRÁDI BRA). - 22. Lučatín (1987 MARHOLD SAV). - 25. Horná Štubňa, near the railway station (1982 MARHOLD SLO). - 30a. Solivar (s.a. HAZSLINSZKY BP). - 30b. Malcov (1985 MARHOLD SAV). - 30c. Nižná Polianka (1987 MARHOLD SAV). - **Carpaticum orientale.** 31. Pčolinné (1987 MARHOLD SAV).

Austria

Laa a.d. Thaya (1887 BECK SAV). - Mannersdorf a.d. March (1906 VETTER W). - Marchegg (1931 RONNIGER W). - Wien, Brigittenau (1882 BAYER W). - Moosbrun (1865 BAYER WU).

Hungary

I. Matricum. 1. Pálháza, Kemence völgy (1954 JÁVORKA & CSAPODY BP). - 2. Szin, Szelcepuszta (1953 BOROS BP). - 3. Hejőcsaba - Pusztatapolca, Hejő patak (1924 BOROS BP). - 4. Mátraháza, Barátkő hegy (1952 PÓCS & GELENCSÉR BP). - 5. Katalinpuszta (1916 DEGEN BP). - **II. Bakonyicum.** 1. Sikáros (1919 BOROS BP). - 2. Leányvár (1926 BOROS BP). - 3. Olazsfalu (1931 POLGÁR BP). - **III. Praenoricum.** 1. Sopron (1845 BALLAY LWS). - 2. Szombathely (1912 s.coll. BP). - 3. Lenti - Nova (1938 JÁVORKA & ZÓLYOMI BP). - **IV. Eupannonicum.** 1. Hegyeshalom - Miklósfalu, Lajta (1920 BOROS BP). - 2. Csepel, Sziget-újfalu (1865 TAUSCHER WU). - 3. Budapest, Zugló (1930 VAJDA BP). - 4. Hatvan (1928 TUZSON BP). - 5. Bátorliget (1934 SOÓ BP). - **V. Praeillyricum.** 1. Zalaegerseg (1906 SIMONKAI BP). - 2. Babocsa (1923 BOROS BP).

Ukraine

Carpaticum orientale. II. Oblasť Zakarpats'ka, Rajon Velykobereznjans'kyj, Malyj Bereznyj (1956 POPOVIČ UU). - VIII. Oblasť Zakarpats'ka, Rajon Perečyns'kyj, Perečyn, N (1989 MARHOLD & KAHALO SAV). - IX. Oblasť Zakarpats'ka, Rajon Chusts'kyj, Iza, Dolina narcysiv (1989 MARHOLD & KAHALO SAV). - **Pannonicum.** X. Oblasť Zakarpats'ka, Rajon Užhorods'kyj, Mala Dobron' (1989 MARHOLD & KAHALO SAV).

Romania

Distr. Bistriţa-Năsăud. Beclean (1900 REITHOFFER CL).- **Distr. Mureş.** Tîrgu-Mureş (1914 E. I. NYÁRÁDY SIB). - **Distr. Harghita.** Tuşnad (s.a. SCHUR LW). - **Distr. Covasna.** Zagon (1941 HARGITTAI CL). - **Distr. Prahova.** Prahova (1923 GRINŢEŞCU - Fl. Rom. Exs. no. 1705). - **Distr. Braşov.** Hărman (1958 HELTMANN SIB). - **Distr. Sibiu.** Avrig (1990 MARHOLD SAV). - **Distr. Hunedoara.** Orăştie (s.a. UNVERRICHT SIB). - **Distr. Timiş.** Timişoara, Pădurea Casa verde (1960 GOGA SIB). - **Distr. Arad.** Chişineu Chris, "Nadab" (1905

THAISZ BP). - **Distr. Bihor.** Martihaz, Salonta (1955 POP CL). - **Distr. Cluj.** Cluj-Napoca, "Szénafű" (1902 RICHTER BP). - **Distr. Satu Mare.** Satu-Lung (1938 FORSTNER - Fl. Rom. Exs. no. 2762).

Cardamine majovskii MARHOLD et ZÁBORSKÝ

Slovakia

Pannonicum. 8. Strážne, Opátsky piesok (1988 GRULICH MMI). - **Carpaticum occidentale.** 19. Slanec, Kerek (1938 KLÁŠTERSKÝ & DEYL PR). - 20. Strihovce, "Szirthi erdő" (1873 DIETZ [?] BP). - 30c. Rokytovce (1987 MARHOLD SAV). - **Carpaticum orientale.** 31. Snina, E (1987 MARHOLD SAV).

Hungary

I. Matricum. 1. Makkoshotyka, Radvány patak (1962 MOLDVAI BP). - **IV. Eupannonicum.** 4. Zombor, Ferenc-csatorna (1910 PRODAN CL). - 5. Debrecen, Haláp (1938 FELFÖLDY BP). - 6. Buj, Lonyai-csatorna (1986 MARHOLD BP, SAV). - **V. Praeillyricum.** 2. Darány, Nagyberek (1923 BOROS BP).

Ukraine

Carpaticum orientale. II. Oblasť Zakarpats'ka, Rajon Perečyns'kyj, Dubrynyči (1968 s. coll. UU). - III. Oblasť Zakarpats'ka, Rajon Mižgirs'kyj, Nehrovec', Nehrovec' peat bog state nature reserve (1990 MARHOLD & KAHALO SAV). - V. Oblasť Zakarpats'ka, Rajon Rachivs'kyj, Jasynja, valley of the Keveliv stream (1958 MALYNOVS'KYJ LWS). - VIII. Oblasť Zakarpats'ka, Rajon Perečyns'kyj, Perečyn, N (1989 MARHOLD & KAHALO SAV). - IX. Oblasť Zakarpats'ka, Rajon Chusts'kyj, Zamkova hora (1957 VOJNAGIJ LWS). - **Pannonicum.** X. Oblasť Zakarpats'ka, Rajon Užhorods'kyj, Onokivci (1960 PALKO UU).

Romania

Distr. Harghita. Porumbenii Mari, Lacul Racului (1925 E. I. NYÁRÁDY CL). - **Distr. Braşov.** Hărman (1957 HELTMANN SIB). - **Distr. Sibiu.** Tălmaciu, Valea Sadu (1990 MARHOLD SAV). - **Distr. Mehedinţi.** Jiana Veche (1967 PĂUN & GH. POPESCU Fl. Olten. Exs. no. 646). - **Distr. Timiş.** Bieghiu - Făget (1973 TĂUBER CL). - **Distr. Arad.** Ineu - Mocrea (1886 SIMONKAI BP). - **Distr. Cluj.** Cluj-Napoca, Făget (1929 E. I. NYÁRÁDY CL). - **Distr. Giurgiu.** Mihăilesti, Pădurea Epureşti (1955 ŞERBANESCU CL).

Cardamine dentata SCHULT.

Poland

Karpaty Zachodnie. 513.33. Skawina (1950 PAWŁOWSKI KRA, KRAM). - 513.48. Kalwaria Zebrzydowska (1965 BARADZIEJ KRA). - 513.61. Tarnów, Zglobice (1828 HERBICH LW).

Moravia

Pannonicum. 16. Tišnov, Malhostovice (1883 FORMÁNEK BRNM). - 18a. Brno, Ráječek (1908 TEUBER BRNM). - 18b. Hodonín (1901 TEUBER BRNU). - 21a. Hejčín (1966 J. DOSTÁL PR). - 21b. Bílany (1914 V. NÁBĚLEK BRNM). - **Mesophyticum carpaticum.** 80a. Pržno (1905 MACHÁČEK BRNU).

Slovakia

Pannonicum. 4. Abrod (1986 GRULICH MMI). - 6. Pezinok, Cajla, Trnianska dolina (1983 MÁJOVSKÝ SLO). - 8. Strážne (1988 GRULICH MMI). - **Carpaticum occidentale.** 10. Plavecký Peter (1931 PTAČOVSKÝ SAV). - 26b. Strážky (1987 MARHOLD SAV). - 29. Orlov (1985 MARHOLD SAV).

Austria

Krems, Röhrendorf (1871 KERNER WU). - Wien, Kaisermühlen (1920 J. SCHNEIDER W). - Wolfstahl (1918 GÁYER SLO). - Gramatneusiedl (1909 RONNIGER W). - Fischamend (1977 GUTERMANN WU-G).

Hungary
I. Matricum. 5. Veresegyház (1918 BOROS BP). - **IV. Eupannonicum.** 1. Rajka (1920 BOROS BP). - 2. Nagydorog, Szigetpuszta (1920 BOROS BP). - 3. Budapest, Szent Margit Sziget (1941 CSAPODY BP). - 4. Vajdácska (1934 PÉNZES BP). - 6. Demecser (1873 SIMKOVICS BP). - **V. Praeillyricum.** 1. Zákány, Bogdán sziget (1963 KÁROLYI BP). - 2. Balatonmáriafürdő (1956 KÁROLYI BP).

Ukraine
Carpaticum orientale. I. Oblasť L'vivs'ka, Rajon Starosambirs'kyj, Staryj Sambir, Teršiv (1990 MARHOLD & KAHALO SAV). - II. Oblasť L'vivs'ka, Rajon Turkivs'kyj, Turka (1990 MARHOLD & KAHALO SAV). - **Pannonicum.** X. Oblasť Zakarpats'ka, Rajon Užhorods'kyj, Užhorod, Onokivci (1988 MARHOLD & KAHALO SAV).

***Cardamine rivularis* SCHUR**

Romania
Distr. Harghita. Mţii Giurgeului, Hăşmasul Mare - "Öcsén" (1902 SIMONKAI BP). - **Distr. Buzău.** Mţii Vrancei, Vf. Goru (1914 JÁVORKA BP). - **Distr. Prahova.** Mţii Bucegi, Sinaia Casa Peştera (1931 DOMIN & KRAJINA PRC). - **Distr. Dîmboviţa.** Mţii Bucegi, Valea Ialomiţa - Valea Obârşia (1931 E. I. NYÁRÁDY CL). - **Distr. Braşov.** Mţii Bîrsei, Malojeşt (1884 BARTH BP). - **Distr. Argeş.** Mţii Făgăraşului, Valea Capra (1989 MARHOLD SAV). - **Distr. Sibiu.** Mţii Făgăraşului, Valea Arpaşului (1989 MARHOLD SAV). - **Distr. Vîlcea.** Mţii Făgăraşului, Ciortea (s.a. FUSS CL). - **Distr. Gorj.** Mţii Parîngului, Novaci, Rînca (1974 MĄDALSKI, KRAM-hb. MĄD.). - **Distr. Hunedoara.** Mţii Şureanu, Grădistea de Munte (1904 JÁVORKA BP).