IOPB COLUMN

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# IAPT/IOPB chromosome data 21

**Edited by Karol Marhold & Jaromír Kučera**

**DOI** http://dx.doi.org/10.12705/653.44

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All material CHN; collectors: *EA* = Elena A. Andriyanova, *OM* = Olga A. Mochalova; vouchers in MAG.

We acknowledge the financial support provided by the Russian Foundation for Basic Research (grants no. 12-04-00074, no. 12-04-00904, no. 15-29-02498).

**APIACEAE**

*Cicuta virosa* L., 2*n* = 22; Russia, Magadanskaya Oblast', *EA & OM A15007.*
*Magadania olaensis* (Gorovoj & N.S.Pavlova) Pimenov & Lavrova, 2*n* = 22; Russia, Magadanskaya Oblast', *OM M11001.*

**ASTERACEAE**

*Erigeron silenifolius* (Turcz.) Botsch., 2*n* = 18; Russia, Magadanskaya Oblast', *OM M12001.*

**CALLITRICHACEAE**

*Callitriche hermaphroditica* L., 2*n* = 6; Russia, Republic of Sakha (Yakutia), *OM M15026.*
*Callitriche palustris* L., 2*n* = 20; Russia, Magadanskaya Oblast', *OM M15027.*

**PLANTAGINACEAE**

*Plantago camtschatica* Link, 2*n* = 12; Russia, Magadanskaya Oblast', *EA A13149.*

**RANUNCULACEAE**

*Caltha arctica* R.Br., 2*n* = 32; Russia, Magadanskaya Oblast', *OM M12010.*
*Ranunculus gmelinii* DC., 2*n* = 16; Russia, Magadanskaya Oblast', *EA A14005a*. 2*n* = 24; Russia, Magadanskaya Oblast', *EA A14005b*; Russia, Magadanskaya Oblast', *EA & OM A15001*; Russia, Magadanskaya Oblast', *OM & EA M16006*; Russia, Magadanskaya Oblast', *OM M16008*. 2*n* = 32; Russia, Chukotskiy Avtonomnyi Okrug, *EA A15087*; Russia, Magadanskaya Oblast', *EA A14005c*.
*Ranunculus lapponicus* L., 2*n* = 16; Russia, Magadanskaya Oblast', *OM M14010.*
*Ranunculus nipponicus* Nakai, 2*n* = 32; Russia, Magadanskaya Oblast', *EA A14004*; Russia, Magadanskaya Oblast', *OM M14001.*
*Ranunculus pallasii* Schlecht., 2*n* = 32; Russia, Magadanskaya Oblast', *OM & EA M15008.*
*Ranunculus spitzbergensis* Hadac, 2*n* = 24; Russia, Magadanskaya Oblast', *OM M15017.*
*Thacla natans* (Pall.) Deyl & Soják, 2*n* = 16; Russia, Magadanskaya Oblast', *OM & EA M15002.*

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**AMARYLLIDACEAE**

*Sternbergia sicula* Tineo ex Guss., 2*n* = 22; Greece, *BMB 14183*, *BMB 14918.*

**APIACEAE**

*Daucus broteri* Ten., 2*n* = 20; Greece, *BMB 14939.*
*Orlaya kochii* Heywood, 2*n* = 16; Greece, *BMB 14937.*
*Torilis arvensis* (Huds.) Link, 2*n* = 12; Greece, *BMB 14935.*

**ASTERACEAE**

*Antennaria dioica* (L.) Gaertn., 2*n* = 28; Greece, *BMB 15385.*
*Centaurea zuccariniana* DC., 2*n* = 18; Greece, *BMB 14870*, *BMB 14926.*
*Conyza canadensis* (L.) Cronquist s.l., 2*n* = 54; Greece, *BMB 14881*, *BMB 14929*, *BMB 14936.*
*Hypochaeris radicata* L., 2*n* = 8; Greece, *BMB 14938.*
*Lactuca serriola* L., 2*n* = 18; Greece, *BMB 14925.*
*Picris hieracioides* L., 2*n* = 10; Greece, *BMB 14940.*
*Ptilostemon afer* (Jacq.) Greuter, 2*n* = 32; Greece, *BMB 15753*, *BMB 17068.*
*Staehelina petiolata* (L.) Hilliard & B.L.Burtt, 2*n* = 34; Greece, *BMB 14184*, *BMB 15754*, *BMB 16679.*

**BRASSICACEAE**

*Lunaria rediviva* L., 2*n* = 30; Greece, *BMB 15752*, *BMB 16313.*
*Thlaspi ochroleucum* Boiss. & Heldr., 2*n* = 28; Greece, *BMB 14880*, *BMB 15946.*

**CARYOPHYLLACEAE**

*Petrorhagia obcordata* (Margot & Reut.) Greuter & Burdet, 2*n* = 30; Greece, *BMB 14872*, *BMB 14927.*

**FABACEAE**

*Medicago falcata* L., 2*n* = 32; Greece, *BMB 15443.*

All materials for the chromosome column should be submitted electronically to: Karol Marhold, karol.marhold@savba.sk (Institute of Botany, Slovak Academy of Sciences, SK-845 23 Bratislava, Slovakia, and Department of Botany, Charles University, CZ 128-01 Prague, Czech Republic). The full version of this contribution is available in the online edition of TAXON appended to this article. The following citation format is recommended: Baltisberger, M. & Voelger, M. 2006. *Sternbergia sicula*. In: Marhold, K. (ed.), IAPT/IOPB chromosome data 1. *Taxon* 55: 444, E2.

### LAMIACEAE

*Salvia sclarea* L., 2*n* = 22; Greece, *BMB 17491*.
*Scutellaria rubicunda* Willd., 2*n* = 34; Greece, *BMB 14930*.
*Stachys plumosa* Griseb., 2*n* = 34; Greece, *BMB 14874*, *BMB 15054*.

### PLANTAGINACEAE

*Veronica vindobonensis* (M.A.Fisch.) M.A.Fisch., 2*n* = 16; Greece, *BMB 16006*.

### POACEAE

*Aegilops neglecta* Req. ex Bertol., 2*n* = 42; Greece, *BMB 14871*, *BMB 14933*.

### RANUNCULACEAE

*Nigella damascena* L., 2*n* = 12; Greece, *BMB 14931*.
*Ranunculus arvensis* L., 2*n* = 32; France, *MB & K.Krug 13574*, *MB 13714*; Switzerland, *MB & W.Huber 12038*.
*Ranunculus brevifolius* subsp. *pindicus* (Hausskn.) E.Mayer, 2*n* = 16; Greece, *M. Bratteler & A. Widmer 14846*, *MB 13842*.
*Ranunculus bulbosus* L., 2*n* = 16; Switzerland, *MB & W. Huber 12531*.
*Ranunculus friesianus* Jord., 2*n* = 14; Switzerland, *MB 17734*.
*Ranunculus muricatus* L., 2*n* = 48; Greece, *MB & U. Meili 11237*, *MB 11671*.
*Ranunculus paludosus* Poir., 2*n* = 32; Greece, *MB & M. Müller 78/1305*; Greece, *A. Kocyan & A. Widmer 14628*, *MB 13488*; Greece, *A. Kocyan 710*, *MB 15947*.
*Ranunculus repens* L., 2*n* = 32; France, *MB & K. Krug 13573*, *MB 13734*.
*Ranunculus sceleratus* L., 2*n* = 32; Greece, *BMB 14868*, *BMB 14924*; Switzerland, *MB 15444*, *MB 16402*.
*Ranunculus thora* L., 2*n* = 16; Italy, *MB & A. Widmer 13687*, *MB 13739*.

### ROSACEAE

*Geum coccineum* Sm., 2*n* = 42; Greece, *BMB 14879*, *BMB 16022*.
*Geum montanum* L., 2*n* = 42; Greece, *BMB 16662*.
*Geum urbanum* L., 2*n* = 42; Greece, *BMB 16061*.

### SCROPHULARIACEAE

*Scrophularia heterophylla* Willd., 2*n* = 26; Greece, *BMB 14869*, *BMB 14934*.

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All materials CHN, gathered in situ (S France), fixed on flowers (*F*) or bulb root tips (*R*), identified by M. Espeut, and counted by R. Verlaque; vouchers in MARS.

### ASPARAGACEAE

*Muscari baeticum* Blanca & al., 2*n* = 54; *Espeut F12-102*, *F15-101*, *Verlaque R15-51*.
*Muscari olivetorum* Blanca & al., 2*n* = 45; *Espeut F14-103*, *Verlaque R15-50*.

### VIOLACEAE

*Viola biflora* L., 2*n* = 12; *Espeut F14-2*.
*Viola bubanii* Timb., 2*n* = 52; *Espeut F15-4*.
*Viola cornuta* L., 2*n* = 22; *Espeut F14-3*.
*Viola lactea* Sm., 2*n* = ca. 58; *Espeut F07-6*.
*Viola lutea* Huds., 2*n* = 48; *Espeut F14-4*. 2*n* = 50; *Espeut F14-5*.
*Viola parvula* Tineo, 2*n* = 10; *Espeut F05-54*.
*Viola riviniana* Rchb., 2*n* = 40; *Espeut F14-1*.
*Viola tricolor* subsp. *subalpina* (Latourr.) Gaudin, 2*n* = 26; *Espeut F05-53*.

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The study was supported by financial grant under IPLS Project of DBT (BT/PR 4548/INF/22/146/2012) and UGC-RGNF (F1-17.1/2011-12/RGNF-SC-PUN-11224).

### BRASSICACEAE

*Farsetia hamiltonii* Royle, *n* = 18; *KK 31252*.

### CAPPARACEAE

*Dipterygium glaucum* Decne., *n* = 11; *KK 31274*.

### FABACEAE

*Taverniera cuneifolia* (Roth) Arn., *n* = 8; *KK 31253*.
*Tephrosia wallichii* Graham ex Fawcett & Rendle, *n* = 22; *KK 31262*.

### MALVACEAE

*Abelmoschus moschatus* Medik., *n* = 18; *KK 31230*.
*Abutilon ramosum* Guill. & Perr., *n* = 21; *KK 31231*.
*Hibiscus lobatus* (Murray) Kuntze, *n* = 36; *KK 31273*.

### OXALIDACEAE

*Oxalis corymbosa* DC., *n* = 28; *KK 31242*.

### PAPAVERACEAE

*Argemone mexicana* L., *n* = 14; *KK 31212*. *n* = 28; *KK 31209*.

### STERCULIACEAE

*Melhania magnifolia* Blatt. & Hallb., *n* = 30; *KK 31226*.

### TILIACEAE

*Triumfetta rhomboidea* Jacq., *n* = 8; *KK 31206*.

### ZYGOPHYLLACEAE

*Fagonia cretica* L., *n* = 11; *KK 31219*.
*Fagonia schweinfurthii* Hadidi, *n* = 11; *KK 31295*.
*Peganum harmala* L., *n* = 6; *KK 31222*.

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DNA ploidy levels and genome sizes (C-values) were ascertained by *ES* = E. Štubňová, *JK* = J. Kučera and *MS* = M. Slovák. Chromosome numbers, standardized chromosome length measurements and karyotype estimates were obtained by *LM* = L. Mártonfiová. Collectors: *AG* = A. Guttová, *ÅS* = Å. Svensson, *CL* = C.J. Löser, *GJC* = G.J. Cunnel, *IH* = I. Hodálová, *JK* = J. Kučera, *MS* = M. Slovák, *PM*

= P. Mereďa, *PR* = P. Repa, *SG* = S. Godefroid, *TT* = T. Tyler, *UGA* = U.-G. Andersson. Vouchers are deposited in SAV.

This study was supported by the Research and Development Support Agency (project no. APVV-0320-10). The authors wish to thank The Royal Botanic Gardens, Kew (U.K.) and The National Botanic Garden of Belgium for providing seeds of *P. hieracioides* subsp. *hieracioides* (pop. LON and pop. BE2, respectively).

**COMPOSITAE**

*Picris hieracioides* L. subsp. *hieracioides*

2*n* = 2*x* = 10, CHN. Great Britain, *GJC LON 1.*

2*n* ~ 2*x* ~ 10, 2C = 2.10–2.93 pg, FCM. Belgium, *SG BE2–1*, *SG BE2–2*, *SG BE2–3*; Bosnia and Herzegovina, *JK & MS BOS1–1*, *JK & MS BOS1–2*, *JK & MS BOS1–3*; Bulgaria, *JK & MS BG1–1*, *JK & MS BG1–2*, *JK & MS BG1–4*, *JK & MS BG2–1*, *JK & MS BG2–2*, *JK & MS BG2–4*, *JK & MS BG3–2*, *JK & MS BG3–5*, *JK & MS BG3–5a*, *JK & MS BG6–2*, *JK & MS BG6–2a*, *JK & MS BG6–4*; Czech Republic, *JK & MS CZ1–2*, *JK & MS CZ1–4*, *JK & MS CZ1–5*, *JK & MS CZ2–3*, *JK & MS CZ2–3a*, *JK & MS CZ2–4*, *JK & MS CZ3–3*, *JK & MS CZ3–4*, *JK & MS CZ3–5*, *JK & MS CZ4–2*, *JK & MS CZ4–3*, *JK & MS CZ4–4*; Germany, *JK & MS DE1–2*, *JK & MS DE1–4*, *JK & MS DE1–5*, *JK & MS DE2–1*, *JK & MS DE2–1a*, *JK & MS DE2–3*, *JK & MS DE3–1*, *JK & MS DE3–1a*, *JK & MS DE3–3*, *JK & MS KRBA1–1*, *JK & MS KRBA1–2*, *JK & MS KRBA1–3*; Great Britain, *GJC LON1*, *GJC LON2*, *GJC LON3;* Greece, *MS, JK & AG GRC1*, *MS, JK & AG GRC2*, *MS, JK & AG GRC3*, *MS, JK & AG GRE1*, *MS, JK & AG GRE2*, *MS, JK & AG GRE3*; Hungary, *MS, JK & PR HU2–1*, *MS, JK & PR HU2–2*, *MS, JK & PR HU2–3*, *MS, JK & AG HU4–1*, *MS, JK & AG HU4–2*; FYROM Macedonia, *MS, JK & AG MDE1*, *MS, JK & AG MDE2*, *MS, JK & AG MDE3*; Poland, *JK & MS PL4–2*, *JK & MS PL4–3*, *JK & MS PL4–4*; Romania, *MS, JK & PR RO3–1*, *MS, JK & PR RO3–2*, *MS, JK & PR RO3–3*, *MS, JK & PR RO22–1*, *MS, JK & PR RO22–2*, *MS, JK & PR RO22–3*; Republic of Serbia, *JK & MS SUV1–1*, *JK & MS SUV1–2*, *JK & MS SUV1–3*; Slovakia, *MS & JK KOZ1*, *MS & JK KOZ2*, *MS & JK KOZ3*; Sweden, *ÅS*, *UGA & TT SKN1*, *ÅS*, *UGA & TT SKN2*, *ÅS*, *UGA & TT SKN3*; Turkey, *JK & MS TRB1*, *JK & MS TRB2*, *JK & MS TRB3*, *JK & MS IZM1*, *JK & MS IZM3*; Ukraine, *IH & PM CHRE1.*

2*n* ~ 3*x* ~ 15, 2C = 3.83 pg, FCM. Turkey, *JK & MS IZM2.*

*Picris hieracioides* subsp. *hispidissima* (Bartl.) Slovák & Jar.Kučera

2*n* = 2*x* = 10, CHN. Croatia, *MS, JK & AG DUB8.*

2*n* ~ 2*x* ~ 10, 2C = 2.94–3.23 pg, FCM. Croatia, *MS, JK & AG DUB8*, *MS, JK & AG GRC6*, *MS, JK & AG OMI5*, *MS, JK & AG OMI10*, *MS, JK & AG OMI10a, MS, JK & AG PAK5*; Montenegro, *MS, JK & AG LOV3*, *MS, JK & AG LOV3a*, *MS, JK & AG NIK1*, *MS, JK & AG NIK2*, *MS, JK & AG NIK8*, *MS, JK & AG SKA8*, *MS, JK & AG SKA9*, *MS, JK & AG SKA10.*

*Picris hieracioides* subsp. *umbellata* (Schrank) Ces.

2*n* = 2*x* = 10, CHN. Romania, *MS, JK & PR RO11–1*, *MS, JK & PR RO13–1*, *MS, JK & PR RO27–1.*

2*n* ~ 2*x* ~ 10, 2C = 2.90–3.17 pg, FCM. Romania, *MS*, *JK & PR RO11–1*, *MS, JK & PR RO11–2*, *MS, JK & PR RO11–3*, *MS, JK & PR RO13–1*, *MS, JK & PR RO13–2*, *MS, JK & PR RO13–3*, *MS, JK & PR RO27–1*, *MS, JK & PR RO27–2*, *MS, JK & PR RO27–3*, *MS, JK & PR RO31–1*, *MS, JK & PR RO31–2*, *MS, JK & PR RO31–3*, *MS, JK & PR RO35–1*, *MS, JK & PR RO35–2*, *MS, JK & PR RO35–3*; Ukraine, *MS, JK & PR UA1–1.*

2*n* = 4*x* = 20, CHN. Romania, *MS, JK & PR RO31–1.*

2*n* ~ 4*x* ~ 20, 2C = 6.06–6.20 pg, FCM. Romania, *MS, JK & PR RO31–1*, *MS, JK & PR RO31–2*, *MS, JK & PR RO31–3.*

*Picris hieracioides* s.l.

2*n* ~ 2*x* ~ 10, 2C = 2.34–3.03 pg, FCM. Germany, *JK & MS DE4–2*, *JK & MS DE4–2a*, *JK & MS DE4–3*, *CL JEN1*, *CL JEN2*, *CL JEN2a*; Poland, *JK & MS PL1–3*, *JK & MS PL1–3a*, *JK & MS PL1–5*, *JK & MS PL2–1*, *JK & MS PL2–2*, *JK & MS PL2–3*; Sweden, *ÅS*, *UGA & TT OLA1*, *ÅS*, *UGA & TT OLA2*, *ÅS*, *UGA & TT OLA3.*

*Picris olympica* Boiss.

2*n* = 2*x* = 10, CHN. Turkey, *JK & MS BOZ1*, *JK & MS ULU1.*

2*n* ~ 2*x* ~ 10, 2C = 2.72–3.32 pg, FCM. Turkey, *JK & MS BOZ1*, *JK & MS BOZ2*, *JK & MS BOZ3*, *JK & MS ULU1*, *JK & MS ULU2*, *JK & MS ULU3*, *JK & MS ULU4.*

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All materials CHN, gathered in situ in SE France and NW Italy, fixed on flowers (*F*) or seedlings (*S*) produced from seeds collected by the Conservatoire Botanique National Méditerranéen de Porquerolles, and counted by R. Verlaque; vouchers in CBNMED. CBNMED is the herbarium of the Conservatoire Botanique National Méditerranéen de Porquerolles and is stored at 34 avenue Gambetta, 83400 Hyères, France.

**LAMIACEAE**

*Teucrium pseudochamaepitys* L., 2*n* = 60; France, *Pires F14-05.*

**LENTIBULARIACEAE**

*Pinguicula hirtiflora* Ten., 2*n* = 28; France, *Pires F12-19.*

*Pinguicula reichenbachiana* Schindl., 2*n* = 32; France, *Pires F12-15*, *Pires F12-17*, *Pires F12-18*, *Pires S13-03*; Italy, *Pires F12-14*, *Pires S12-16.*

*Pinguicula* cf. *vulgaris* Schindl., 2*n* = 64; France, Pires F12-*13.*

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All material CHN.

**VALERIANACEAE**

*Nardostachys grandiflora* DC., *n* = 39, 2*n* = 78; India, Himachal Pradesh, *Kamini s.n.* (Herbarium, Dr. Y. S. Parmar University of Horticulture & Forestry, Himachal Pradesh, India, no. 8285).

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All materials CHN; collected in India; collector: *VS* = Vijay Singh; vouchers in PUN.

The study is supported by financial grant under UGC-BSR Fellowship scheme (Award Letter no. 6007/04/04/2015) and IPLS-DBT (Reference number: BT/PR 4548/INF/22/146/2012).

**ASTERACEAE**
*Aster himalaicus* C.B.Clarke, *n* = 9; *VS 31308.*
*Cremanthodium ellisii* (Hook.f.) Kitam., *n* = 29; *VS 31348.*
*Saussurea auriculata* (DC.) Sch.Bip., *n* = 16; *VS 31358.*
*Saussurea piptathera* Edgew., *n* = 13; *VS 31354.*
*Saussurea roylei* C.B.Clarke, *n* = 17; *VS 31350.*
*Saussurea taraxacifolia* Wall. ex DC., *n* = 16; *VS 31345.*
*Synedrella vialis* (Less.) A.Gray, *n* = 12; *VS 31338.*
*Waldheimia glabra* (Decne.) Regel, *n* = 12; *VS 31355.*

**BORAGINACEAE**
*Cynoglossum glochidiatum* Wall. ex Benth., *n* = 12; *VS 31371.*
*Hackelia uncinata* (Royle ex Benth.) C.E.C.Fisch., *n* = 12; *VS 31373.*

**CAMPANULACEAE**
*Campanula aristata* Wall., *n* = 14; *VS 30306.*

**GENTIANACEAE**
*Gentiana carinata* Griseb., *n* = 10; *VS 30313.*
*Gentiana moorcroftiana* Wall. ex G.Don, *n* = 10; *VS 30315.*

**PLANTAGINACEAE**
*Plantago himalaica* Pilg., *n* = 12; *VS 31320.*

**PRIMULACEAE**
*Primula elliptica* Royle, *n* = 11; *VS 31374.*

**SCROPHULARIACEAE**
*Euphrasia officinalis* L., *n* = 44; *VS 31376.*
*Pedicularis heterodonta* Pančić ex Janka, *n* = 8; *VS 31378.*
*Pedicularis oederi* Vahl, *n* = 8; *VS 30311.*
*Scrophularia decomposita* Royle ex Benth., *n* = 15; *VS 31373.*
*Veronica himalensis* D.Don, *n* = 16; *VS 59503.*

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# IAPT/IOPB chromosome data 21 [extended online version]

**Edited by Karol Marhold & Jaromír Kučera**

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All cytological investigations have been carried out on root tips of plants and root tips of seedlings, pretreated in 0.2% colchicine, fixed in methanol-acetic acid (3:1) and stained in 1% acetic hematoxylin (Smirnov, 1968).

We acknowledge the financial support provided by the Russian Foundation for Basic Research (grants no. 12-04-00074, no. 12-04-00904, no. 15-29-02498).

**APIACEAE**

*Cicuta virosa* L.

2*n* = 22, CHN. Russia, North of Far East, Magadanskaya Oblast', Olskii Raion, in vicinity of Arman settlement, near the bridge over Shirokaya River, in the pool, 59°42′N, 150°01′E, 7 Jul 2015, *E. Andriyanova & O. Mochalova A15007* (MAG).

*Magadania olaensis* (Gorovoj & N.S.Pavlova) Pimenov & Lavrova

2*n* = 22, CHN. Russia, North of Far East, Magadanskaya Oblast', Khasynskii Raion, Olskoe Plateau, the upper course of the Ola River, Bazaltovii stream, the brushwood of *Duschekia fruticosa* and *Betula lanata* on the slope, 60°38′N, 149°28′E, 31 Aug 2011, *O. Mochalova M11001* (MAG) [Fig. 1].

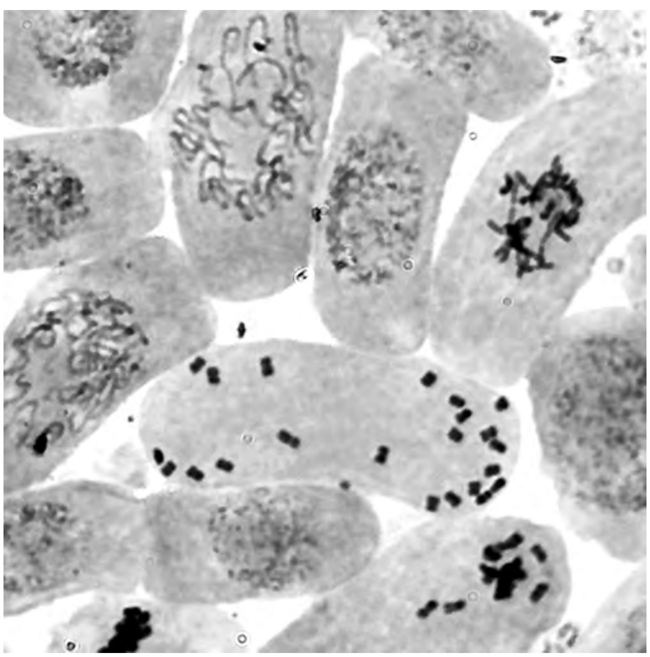

**Fig. 1.** *Magadania olaensis*, 2*n* = 22 (*O. Mochalova M11001*, MAG).

**ASTERACEAE**

*Erigeron silenifolius* (Turcz.) Botsch.

2*n* = 18, CHN. Russia, North of Far East, Magadanskaya Oblast', Khasynskii Raion, Kheta River, flooded forest of *Chosenia arbutifolia*, 61°04′N 151°22′E, 13 Jul 2012, *O. Mochalova M12001* (MAG).

**CALLITRICHACEAE**

*Callitriche hermaphroditica* L.

2*n* = 6, CHN. Russia, North of Far East, Republic of Sakha (Yakutia), Verkhnekolymskii Raion, Kolyma River, 10 km of Mangazeika River mouth, 66°04′N, 150°43′E, 9 Aug 2015, *O. Mochalova M15026* (MAG).

*Callitriche palustris* L.

2*n* = 20, CHN. Russia, North of Far East, Magadanskaya Oblast', Olskii Raion, in vicinity of Arman settlement, near the bridge over Shirokaya River, sand bank, 59°42′N, 150°01′E, 7 Jul 2015, *O. Mochalova M15027* (MAG).

**PLANTAGINACEAE**

*Plantago camtschatica* Link

2*n* = 12, CHN. Russia, North of Far East, Magadanskaya Oblast', Olskii Raion, near the mouth of Oksa River, meadow on the steep slope, 59°36′N, 150°27′E, 31 Aug 2013, *E. Andriyanova A13149* (MAG).

**RANUNCULACEAE**

*Caltha arctica* R.Br.

2*n* = 32, CHN. Russia, North of Far East, Magadanskaya Oblast', Olskii Raion, Lankovaya River Basin, in the middle course of the Nalednii Stream, stream bank, 09°44′N, 152°10′E, 11 Aug 2012, *O. Mochalova M12010* (MAG).

*Ranunculus gmelinii* DC.

2*n* = 16, CHN. Russia, North of Far East, Magadanskaya Oblast', Olskii Raion, in vicinity of Ola settlement, Uglikanka River, non-freezing sand spits, 59°36′N, 151°18′E, 1 Jul 2014, *E. Andriyanova A14005a* (MAG).

2*n* = 24, CHN. Russia, North of Far East, Magadanskaya Oblast', Olskii Raion, in vicinity of Ola settlement, Uglikanka River, non-freezing sand spits, 59°36′N, 151°18′E, 1 Jul 2014, *E. Andriyanova A14005b* (MAG); Russia, North of Far East, Magadanskaya Oblast', Olskii Raion, in vicinity of Ola settlement, Uglikanka River, non-freezing sand spits, 59°36′N, 151°18′E, 5 Mar 2015, *E. Andriyanova & O. Mochalova A15001* (MAG); Russia, North of Far East, Magadanskaya Oblast', Olskii Raion, in vicinity of Ola settlement, Uglikanka River, non-freezing sand spits, 59°36′N, 151°18′E, 14 Mar 2016, *O. Mochalova & E. Andriyanova M16006* (MAG); Russia, North of Far East, Magadanskaya Oblast', Olskii Raion, the Lower Yama River, Allel'niy Stream, non-freezing sand spits, 153°15′N, 59°51′E, 10 Apr 2016, *O. Mochalova M16008* (MAG).

2*n* = 32, CHN. Russia, North of Far East, Chukotskii Avtonomnyi Okrug, Bilibinskii Raion, the upper course of the Karalveem River, in the pool, 66°56′N, 166°51′E, 18 Jul 2015, *E. Andriyanova A15087* (MAG); Russia, North of Far East, Magadanskaya Oblast', Olskii Raion, in vicinity of Ola settlement, Uglikanka River, non-freezing

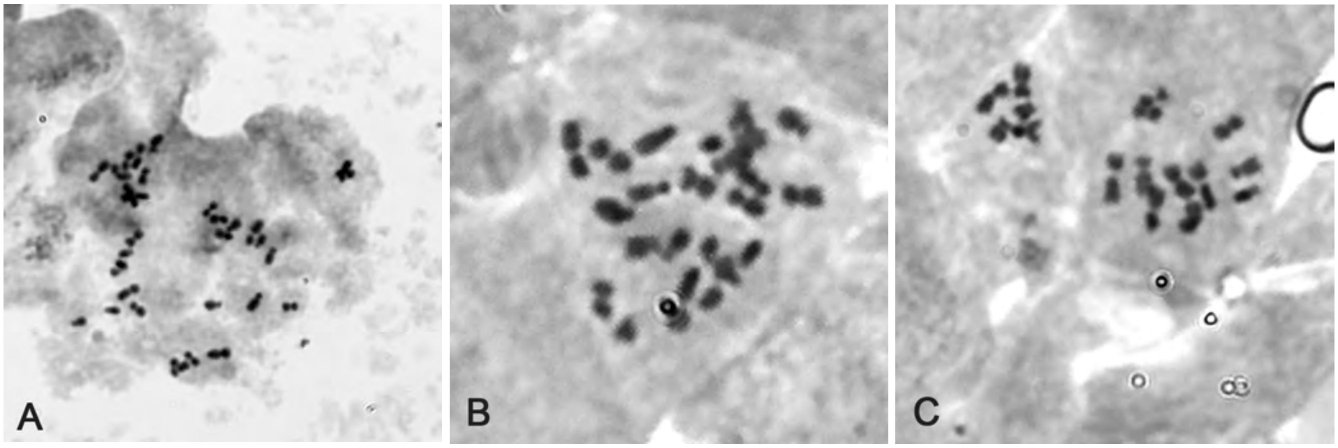


**Fig. 2. A,** *Ranunculus gmelinii*, 2*n* = 32 (*E. Andriyanova A14005c*, MAG); **B,** *Ranunculus gmelinii*, 2*n* = 24 (*E. Andriyanova A14005b*, MAG); **C,** *Ranunculus gmelinii*, 2*n* = 16 (*E. Andriyanova A14005a*, MAG).

sand spits, 59°36′N, 151°18′E, 1 Jul 2014, *E. Andriyanova A14005c* (MAG).

There by three different chromosome numbers were registered in Uglikanka River (Fig. 2A–C). In summer samples (1 Jul 2014) we have found all of known chromosome numbers for several morphologically identical plants. In early spring (March and April), when the most part of river candied with ice, we have registered only 2*n*=24.

*Ranunculus lapponicus* L.

2*n* = 16, CHN. Russia, North of Far East, Magadanskaya Oblast', Severo-Evenskii Raion, in vicinity of Evensk settlement, in the pool, 61°55′N, 159°16′E, 18 Jul 2014, *O. Mochalova M14010 (*MAG*).*

*Ranunculus nipponicus* Nakai

2*n* = 32, CHN. Russia, North of Far East, Magadanskaya Oblast', Olskii Raion, in vicinity of Ola settlement, Uglikanka River, non-freezing sand spits, 59°36′N, 151°18′E, 1 Jul 2014, *E. Andriyanova A14004* (MAG); Russia, North of Far East, Magadanskaya Oblast', Olskii Raion, the lower reaches of the Yama River, Neuter Stream, non-freezing sand spits, 153°16′N, 59°54′E, 13 Mar 2014, *O. Mochalova M14001* (MAG).

*Ranunculus pallasii* Schlecht.

2*n* = 32, CHN. Russia, North of Far East, Magadanskaya Oblast', Olskii Raion, in vicinity of Arman settlement, near the bridge over Shirokaya River, in the pool side, 59°45′N, 149°28′E, 7 Jul 2015, *O. Mochalova & E. Andriyanova M15008* (MAG).

*Ranunculus spitzbergensis* Hadac

2*n* = 24, CHN. Russia, North of Far East, Magadanskaya Oblast', Olskii Raion, in vicinity of Priustjevoi stream, thermokarstic lake, 59°46′N, 149°28′E, 15 Jul 2015, *O. Mochalova M15017* (MAG).

*Thacla natans* (Pall.) Deyl & Soják

2*n* = 16, CHN. Russia, North of Far East, Magadanskaya Oblast', Olskii Raion, in vicinity of Ola settlement, near the road Magadan–Ola, in the pool side, 59°34′N, 151°13′E, 23 May 2015, *O. Mochalova & E. Andriyanova M15002* (MAG).

**Literature cited**

**Smirnov, Yu.A.** 1968. Uskorennyi metod issledovania somaticheskikh khromosom plodovykh [Accelerated method for studying somatic chromosomes in fruit trees]. *Tsitologia* 10: 1132–1134. [in Russian]

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The taxa are arranged alphabetically. Nomenclature mostly corresponds to IPNI (2015–), names not included in IPNI follow MED-CHECKLIST (Greuter & al., 1989). All plants originate from natural habitats. Geographic indications are given for each site. The indications of Greek sites have been adapted to the new organisation of Greece which was part of the "Kallikratis" administrative reform starting on 1 Jan 2011 (informations and maps see https://en.wikipedia.org/wiki/Regional_units_of_Greece). The identification numbers refer to the collection number of the respective herbarium specimens deposited in the herbarium Z+ZT.

Seeds or living plants have been sampled at the sites and plants were cultivated in the greenhouse. All investigations have been carried out on root tips (method see Baltisberger & Widmer, 2009). Indications of chromosome numbers in literature were checked with Goldblatt & Johnson (1979–). Deviating or interesting data are discussed. Nomenclature for chromosome morphology follows Levan & al. (1964) who distinguish four groups of chromosomes characterized by the arm ratio (long arm to short arm; metacentric chromosomes with arm ratios between 1.0 and 1.7, submetacentric 1.7–3.0, subtelocentric 3.0–7.0, and acrocentric more than 7.0).

**AMARYLLIDACEAE**

*Sternbergia sicula* Tineo ex Guss.

2*n* = 22, CHN. Greece, Crete, S of Iraklio, W of Archanes, Mt. Jouchtas, rocky slope, 800 m, 7 Oct 2009, *B. & M. Baltisberger 14183*, *B. & M. Baltisberger 14918* (Z+ZT).

**APIACEAE**

*Daucus broteri* Ten.

2*n* = 20, CHN. Greece, Thessaly, NW of Trikkala, between Kastraki and Kalambaka, rocky slope, 300−400 m, 23 Jul 2011, *B. & M. Baltisberger 14939* (Z+ZT).

*Orlaya kochii* Heywood

2*n* = 16, CHN. Greece, Central Macedonia, E of Mt. Olympus, gorge Enipea near Litochoro, rocky slope, 100−200 m, 21 Jul 2011, *B. & M. Baltisberger 14937* (Z+ZT).

*Torilis arvensis* (Huds.) Link

2*n* = 12, CHN. Greece, Central Macedonia, E of Mt. Olympus, gorge Enipea near Litochoro, rocky slope, 100–200 m, 21 Jul 2011, *B. & M. Baltisberger 14935* (Z+ZT).

*Torilis arvensis* is a difficult complex with several taxa mostly treated as subspecies. The plants investigated best fit with *T. arvensis* subsp. *arvensis*. They are diploid with 2*n* = 12 chromosomes confirming the many indications in literature. The karyotype consists of 2 metacentric, 8 submetacentric and 2 subtelocentric chromosomes (Fig. 1A) corresponding with the karyotypes given by Hamal & Koul (1988) and Baltisberger & Baltisberger (1995).

### ASTERACEAE

*Antennaria dioica* (L.) Gaertn.

2*n* = 28, CHN. Greece, Central Macedonia, WNW of Edessa, SE slope of Mt. Kajmakcalan, above Voras Ski Resort, rocky meadow, 2100–2200 m, 2 Aug 2011, *B. & M. Baltisberger 15385* (Z+ZT).

*Centaurea zuccariniana* DC.

2*n* = 18, CHN. Greece, Thessalia, NW of Trikkala, between Kastraki and Kalambaka, rocky slope, 300–400 m, 23 Jul 2011, *B. & M. Baltisberger 14870*, *B. & M. Baltisberger 14926* (Z+ZT).

*Conyza canadensis* (L.) Cronquist s.l.

2*n* = 54, CHN. Greece, Central Macedonia, NNE of Thessaloniki, Kerkini at lake Kerkini, ruderal place, 40 m, 4 Aug 2011, *B. & M. Baltisberger 14881*, *B. & M. Baltisberger 14929*, *B. & M. Baltisberger 14936* (Z+ZT).

*Conyza canadensis* (= *Erigeron canadensis* L.) s.l. native to America is now introduced in most countries of Europe including the Mediterranean area (Halacsy, 1902; Rechinger, 1943a; Yannitsaros & Economidou, 1974). It is mostly divided into three taxa, viz. *C. bonariensis* (L.) Cronquist, *C. canadensis*, and *C. sumatrensis* (Retz.) E.Walker (Danin, 1976a; Baltisberger & Lippert, 1987; Hess & al., 2015). The taxa are very variable, and the delimitations of the respective entities are weak and overlapping (Cronquist, 1976; Danin, 1976b). This is also demonstrated by the plants from the investigated population from Kerkini. The plants sampled at the ruderal place are rather small (up to 40 cm) and not branched, they show simple leaves, the capitula are arranged in a paniculate inflorescence, and the rather densely hairy involucre is 3–5 mm (*B. & M. Baltisberger 14881*). From the germinated seeds numerous plants grew up and flowered. All plants in cultivation were much taller than the plants from the natural habitat being up to 1 m high which might be due to the conditions (no concurrence, enough nutrient and water). Two kinds of off-spring (without intermediate plants) could be observed: Plants of a first type were similar to the plants from the natural habitat but being taller and the leaves showing sparse teeth (*B. & M. Baltisberger 14936*), and on the other hand plants of a second type were much branched, with deeply pinnatisect leaves and with elongate lateral branches with numerous capitula the longer branches clearly overtopping the main axis (*B. & M. Baltisberger 14929*). Interestingly the capitula of both kinds of offspring were similar to those of the plants from the natural habitat.

Taking into account these morphological characters the plants of the respective types should probably be assigned to different taxa: Plants from the natural habitat as well as those of the first type of cultivated plants best match with *C. canadensis* but the plants from the second type would be *C. bonariensis*. All cytological indications in literature for *C. canadensis* give the diploid chromosome number 2*n* = 2*x* = 18 while *C. bonariensis* seems to be hexaploid as most records indicate the chromosome number of 2*n* = 6*x* = 54 (or *n* = 3*x* = 27). All investigated plants of both types showed 2*n* = 54 chromosomes (Fig. 1B). The question remains open if either hexaploid *C. canadensis* exist or *C. bonariensis* shows an extremely high morphological variabilily.

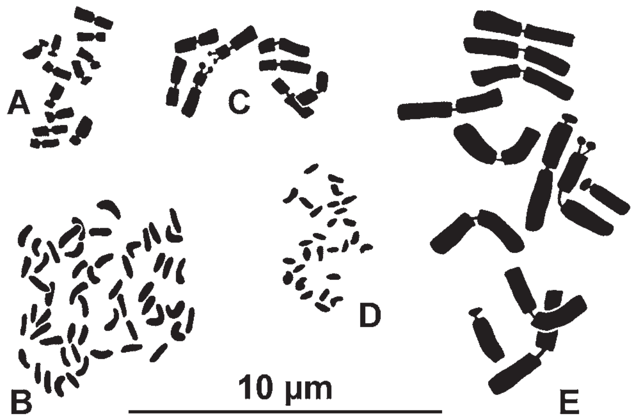


**Fig. 1.** Somatic metaphases. **A,** *Torilis arvensis* (2*n* = 12); **B,** *Conyza canadensis* s.l. (2*n* = 54); **C,** *Hypochaeris radicata* (2*n* = 8); **D,** *Thlaspi ochroleucum* (2*n* = 28); **E,** *Nigella damascena* (2*n* = 12).

*Hypochaeris radicata* L.

2*n* = 8, CHN. Greece, Epirus, SSW of Ioannina, archeological site of Dodona, ruderal place, 500 m, 26 Jul 2011, *B. & M. Baltisberger 14939* (Z+ZT).

The genus *Hypochaeris* is rather variable concerning the basic chromosome number (*x* = 3, 4, 5) as well as the karyotypes of the respective taxa (Mugnier & Siljak-Yakovlev, 1987; Siljak-Yakovlev, 1996). The plants of *H. radicata* investigated showed 2*n* = 2*x* = 8 chromosomes corroborating earlier indications in literature. The plants had a karyotype of two metacentric, four meta- to submetacentric and two submetacentric chromosomes, the latter with satellites (Fig. 1C) the metacentric chromosomes being the smallest ones. Similar karyotypes for *H. radicata* are given by Barghi & al. (1989), Ruas & al. (1995), Siljak-Yakovlev (1996), Dimitrova (1999), and Oberprieler & Vogt (2002). A slightly different karyotype is presented by Serra & al. (2001) indicating similar chromosome types but with four (instead of two) satellite chromosomes.

*Lactuca serriola* L.

2*n* = 18, CHN. Greece, Epirus, NNW of Ioannina, W of Mt. Timphi, village Papingo, ruderal place, 950 m, 27 Jul 2011, *B. & M. Baltisberger 14925* (Z+ZT).

*Picris hieracioides* L.

2*n* = 10, CHN. Greece, Epirus, SSW of Ioannina, archeological site of Dodona, ruderal place, 500 m, 26 Jul 2011, *B. & M. Baltisberger 14940* (Z+ZT).

*Ptilostemon afer* (Jacq.) Greuter

2*n* = 32, CHN. Greece, West Macedonia, lakeside of lake Megali Prespa, SW of Psarades, near Panagia Eleousa, 850 m, 31 Jul 2011, *B. & M. Baltisberger 15753*, *B. & M. Baltisberger 17068* (Z+ZT).

*Staehelina petiolata* (L.) Hilliard & B.L.Burtt

2*n* = 34, CHN. Greece, Crete, S of Iraklio, W of Archanes, Mt. Jouchtas, rocky slope, 800 m, 7 Oct 2009, *B. & M. Baltisberger 14184*, *B. & M. Baltisberger 15754*, *B. & M. Baltisberger 16679* (Z+ZT).

In Greece (including Crete) three species of *Staehelina* occur, viz. *S. fruticosa* L. endemic to S Peloponnese, Karpathos, and Crete, *S. petiolata* endemic to Crete, and *S. uniflosculosa* Sm. growing in S and W parts of the Balkan Peninsula (Halacsy, 1902; Hayek & Markgraf, 1931; Rechinger, 1943a, b; Do Amaral Franco, 1976). The chromosome numbers within the genus *Staehelina* are not uniform (e.g., 2*n* = 30, 34) but all three Greek species show the same chromosome number of 2*n* = 34 (resp. *n* = 17): *S. fruticosa* (De Montmollin, 1986), *S. petiolata* (Phitos & Kamari, 1984; Garnatje & al., 2004), and *S. uniflosculosa* Sm. (Baltisberger, 1993, not included in Goldblatt & Johnson, 1979–). The investigated plants showed the same chromosome number of 2*n* = 34 confirming earlier counts.

Garnatje & al. (2004) indicate 2*n* = 30 for *S. uniflosculosa* the investigated plant material originating from the Botanical Garden Berlin-Dahlem. As all *Staehelina*-taxa growing in Greece and Crete (see above) have 2*n* = 34 chromosomes it is not clear if the chromosome number indicated by Garnatje & al. (2004) is based on a confusion of the botanical garden, on a misidentification of the plants, on a printing error, or if *S. uniflosculosa* really shows different chromosome numbers.

**BRASSICACEAE**

*Lunaria rediviva* L.

2*n* = 30, CHN. Greece, Thessaly, NW of Trikkala, between Kastraki and Kalambaka, rocky slope, 300–400 m, 23 Jul 2011, *B. & M. Baltisberger 15752*, *B. & M. Baltisberger 16313* (Z+ZT).

*Thlaspi ochroleucum* Boiss. & Heldr.

2*n* = 28, CHN. Greece, Central Macedonia, WNW of Edessa, SE slope of Mt. Kajmakcalan, above Voras Ski Resort, rocky meadow, 2100–2200 m, 2 Aug 2011, *B. & M. Baltisberger 14880*, *B. & M. Baltisberger 15946* (Z+ZT).

*Thlaspi ochroleucum* grows in grasslands in the mountains of the Balkan Peninsula (Clapham & Akeroyd, 1993). The diploid chromosome number 2*n* = 2*x* = 14 is known from two mountains in southern Greece (Mt. Timfristos and Mt. Vardousia, both Central Greece; Franzen & Gustavsson, 1983). The plants of Mt. Kajmakcalan in northern Greece on the border to Macedonia proved to be tetraploid with 2*n* = 4*x* = 28 chromosomes (Fig. 1D) which is a new ploidy level for this species.

**CARYOPHYLLACEAE**

*Petrorhagia obcordata* (Margot & Reut.) Greuter & Burdet

2*n* = 30, CHN. Greece, Epirus, NNW of Ioannina, W of Mt. Timphi, Papingo, ruderal place, 950 m, 27 Jul 2011, *B. & M. Baltisberger 14872*, *B. & M. Baltisberger 14927* (Z+ZT).

**FABACEAE**

*Medicago falcata* L.

2*n* = 32, CHN. Greece, West Macedonia, lake Mikri Prespa, island Agios Achilleios, rocky slope, 860–900 m, 30 Jul 2011, *B. & M. Baltisberger 15443* (Z+ZT).

**LAMIACEAE**

*Salvia sclarea* L.

2*n* = 22, CHN. Greece, Thessaly, NW of Trikkala, between Kastraki and Kalambaka, rocky slope, 300–400 m, 23 Jul 2011, *B. & M. Baltisberger 17491* (Z+ZT).

*Scutellaria rubicunda* Willd.

2*n* = 34, CHN. Greece, Thessaly, NW of Trikkala, between Kastraki and Kalambaka, rocky slope, 300–400 m, 23 Jul 2011, *B. & M. Baltisberger 14930* (Z+ZT).

*Stachys plumosa* Griseb.

2*n* = 34, CHN. Greece, West Macedonia, lake Mikri Prespa, island Agios Achilleios, rocky slope, 860–900 m, 30 Jul 2011, *B. & M. Baltisberger 14874*, *B. & M. Baltisberger 15054* (Z+ZT).

**PLANTAGINACEAE**

*Veronica vindobonensis* (M.A.Fisch.) M.A.Fisch.

2*n* = 16, CHN. Greece, Thessaly, NW of Trikkala, between Kastraki and Kalambaka, rocky slope, 300–400 m, 23 Jul 2011, *B. & M. Baltisberger 16006* (Z+ZT).

**POACEAE**

*Aegilops neglecta* Req. ex Bertol.

2*n* = 42, CHN. Greece, Epirus, NNW of Ioannina, W of Mt. Timphi, Papingo, ruderal place, 950 m, 27 Jul 2011, *B. & M. Baltisberger 14871*, *B. & M. Baltisberger 14933* (Z+ZT).

For *Aegilops neglecta* tetraploid plants with 2*n* = 4*x* = 28 as well as hexaploid plants with 2*n* = 6*x* = 42 are known. The plants investigated here proved to be hexaploid.

**RANUNCULACEAE**

*Nigella damascena* L.

2*n* = 12, CHN. Greece, Epirus, NNW of Ioannina, W of Mt. Timphi, Papingo, ruderal place, 950 m, 27 Jul 2011, *B. & M. Baltisberger 14931* (Z+ZT).

*Nigella damascena* is a Mediterranean species and frequently cultivated for ornament elsewhere. As all taxa of *Nigella* it is diploid with 2*n* = 2*x* = 12 chromosomes as was confirmed by the plants investigated. The karyotype is asymmetric with ten metacentric and two subtelo- to acrocentric chromosomes, two metacentric chromosomes bearing satellites (Fig. 1E). Similar karyotypes (sometimes indicating more metacentric chromosomes with satellites) are given by Bhattacharyya (1958), Gilot-Delhalle (1970), Capineri & al. (1978), Datta & Biswas (1983), Baltisberger & Baltisberger (1995), Mitra & Bhowmik (1996), Datta & Saha (2003), and Ghosh & Datta (2006).

*Ranunculus arvensis* L.

2*n* = 32, CHN. France, Hautes Alpes, WNW of Gap, near Rabou, weed in grain field, 1100 m, 11 May 2000, *M. Baltisberger & K. Krug 13574*, *M. Baltisberger 13714* (Z+ZT); Switzerland, ct. Valais, E of Leuk, Brentjong, weed in grain field, 920–950 m, 20 Jun 1989, *M. Baltisberger & W. Huber 12038* (Z+ZT).

*Ranunculus brevifolius* subsp. *pindicus* (Hausskn.) E.Mayer

2*n* = 16, CHN. Greece, Central Greece, Mt. Parnassos, calcarous scree, 2200–2350 m, 12 Jul 2001, *M. Bratteler & A. Widmer 14846*, *M. Baltisberger 13842* (Z+ZT).

*Ranunculus brevifolius* Ten. belongs to *R.* sect. *Thora* DC. which comprises in Europe three species viz. *R. brevifolius*, *R. hybridus* Biria, and *R. thora* L. all plants having undivided cauline leaves, yellow flowers, and growing in stony habitats in the mountains of central and southern Europe. *Ranunculus hybridus* and *R. thora* each are morphologically rather homogeneous and grow in the southern parts of the Alps and a bit southwards. But *R. brevifolius* restricted to more southern mountains in Italy and the Balkan Peninsula shows morphological variation correlated with geographic distribution: Plants from central Italy as well as Albania and Montenegro (named *R. brevifolius* subsp. *brevifolius*) differ from those from Greece (including Crete) in number and dissection of basal leaves and in the size of the achenes. Greek plants have more numerous and more deeply lobed basal leaves and smaller achenes. They are named *R. brevifolius* subsp. *pindicus*. The differences between the two subspecies are weak and probably not consistent but interestingly the two subspecies show a clear disjunct geographic distribution. All taxa of *R.* sect. *Thora* are diploid with 2*n* = 2*x* = 16 chromosomes as was confirmed by the plants investigated.

*Ranunculus bulbosus* L.

2*n* = 16, CHN. Switzerland, ct. Valais, E of Leuk, Brentjong, dry place, 920–950 m, 20 Jun 1989, *M. Baltisberger & W. Huber 12531* (Z+ZT).

*Ranunculus friesianus* Jord.

2*n* = 14, CHN. Switzerland, ct. Zürich, Zürich, Universitätstrasse 6–16, weed in herbaceous border, 23 Jun 2015, *M. Baltisberger 17734* (Z+ZT).

*Ranunculus muricatus* L.

2*n* = 48, CHN. Greece, West Greece, on the road from Patras to Kalavritsa, near Kalanos, wet place, 650 m, 16 Jun 1987, *M. Baltisberger & U. Meili 11237*, *M. Baltisberger 11671* (Z+ZT).

*Ranunculus paludosus* Poir.

2*n* = 32, CHN. Greece, Central Greece, between Amfissa and Nafpaktos, NW of Lidorikiou, near Pendayi, roadside, 1050 m, 18 Jun 1977, *M. Baltisberger & M. Müller 78/1305* (Z+ZT); Greece, Attica, Kithira, near airport, open place, 27 Mar 1998, *A. Kocyan & A. Widmer 14628*, *M. Baltisberger 13488* (Z+ZT); Greece, Attica, Kithira, between Livadi and Chora, olive grove, 1 May 2009, *A. Kocyan 710*, *M. Baltisberger 15947* (Z+ZT).

*Ranunculus repens* L.

2*n* = 32, CHN. France, Hautes Alpes, WNW of Gap, near Rabou, roadside, 1100 m, 11 May 2000, *M. Baltisberger & K. Krug 13573*, *M. Baltisberger 13734* (Z+ZT).

*Ranunculus sceleratus* L.

2*n* = 32, CHN. Greece, Central Macedonia, SW of Thessaloniki, S of Katerini, archeological site of Dion, wet place, 120 m, 18 Jul 2011, *B. & M. Baltisberger 14868*, *B. & M. Baltisberger 14924* (Z+ZT); Switzerland, ct. Zürich, Zürich, Seebach, wet place, 430 m, 26 Jul 2012, *M. Baltisberger 15444*, *M. Baltisberger 16402* (Z+ZT).

*Ranunculus thora* L.

2*n* = 16, CHN. Italy, Alpi Bergamasche, WSW of Riva del Garda, Corno della Marogna, 1850 m, 31 Jul 2000, *M. Baltisberger & A. Widmer 13687*, *M. Baltisberger 13739* (Z+ZT).

### ROSACEAE

*Geum coccineum* Sm.

2*n* = 42, CHN. Greece, Central Macedonia, WNW of Edessa, SE slope of Mt. Kajmakcalan, above Voras Ski Resort, rocky meadow, 2100–2200 m, 2 Aug 2011, *B. & M. Baltisberger 14879*, *B. & M. Baltisberger 16022* (Z+ZT).

*Geum montanum* L.

2*n* = 42, CHN. Greece, Central Macedonia, WNW of Edessa, SE slope of Mt. Kajmakcalan, above Voras Ski Resort, rocky meadow, 2100–2200 m, 2 Aug 2011, *B. & M. Baltisberger 16662* (Z+ZT).

*Geum urbanum* L.

2*n* = 42, CHN. Greece, Epirus, NNW of Ioannina, W of Mt. Timphi, Papingo, ruderal place, 950 m, 27 Jul 2011, *B. & M. Baltisberger 16061* (Z+ZT).

### SCROPHULARIACEAE

*Scrophularia heterophylla* Willd.

2*n* = 26, CHN. Greece, Central Macedonia, E of Mt. Olympus, gorge Enipea near Litochoro, rocky slope, 100–200 m, 21 Jul 2011, *B. & M. Baltisberger 14869*, *B. & M. Baltisberger 14934* (Z+ZT).

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All materials gathered in situ (S France), fixed on flowers (*F*) or bulb root tips (*R*), identified by M. Espeut, and counted by R. Verlaque.

▼ First chromosome counts from French continental populations.

**ASPARAGACEAE**

▼ *Muscari baeticum* Blanca & al.

2*n* = 54, CHN. France, Pyrénées-Orientales, commune of Serdinya, Mt Coronat, Roc de San Julia, 1500 m, rocky grassland on south-facing steep slope, 42°35′21.2″N, 02°17′50.4″E, 17 Apr 2012, *Espeut F12-102* (MARS); France, Pyrénées-Orientales, commune of Conat, Pla de Horts, Mt Coronat, 1440 m, on rocky grassland-open shrubland mosaic, 42°35′57.6″N, 02°19′38″E, 25 May 2015, *Espeut F15-101* (MARS), *Verlaque R15-51* (MARS) [Fig. 1A].

▼ *Muscari olivetorum* Blanca & al.

2*n* = 45, CHN. France, Pyrénées-Orientales, commune of Montner, Mt Força Real, 300 m, Mediterranean grassland, 13 Apr 2014, *Espeut F14-103* (MARS), *Verlaque R15-50* (MARS) [Fig. 1B].

It is the first time that these two *Muscari* species have been found outside of Spain. All these French localities were discovered by M. Espeut. The exact location of *M. olivetorum* is not indicated to protect the only known French locality. At the French localities, there were also some Spanish species growing that are at their northern limit: *Platycapnos tenuilobus* Pomel and *Fumaria petteri* subsp. *calcarata* (Cadevall) Lidén & Soler, on Mt Força Real, and *Sarcocapnos enneaphylla* (L.) DC. and *Hormatophylla lapeyrousiana* (Jord.) P.Küpfer on Mt Coronat. In the *Muscari* subg. *Botryanthus* (Kunth) Zahar., the orophyte *M. baeticum* and *M. olivetorum* of cultivated lands have recently been described in the highly polymorphic and polyploid complex *M. neglectum* Guss. (= *M. racemosum* auct.) (Suarez-Santiago & al., 2007; Suarez-Santiago & Blanca, 2013).

For these species, our counts are in agreement with the previous reports (under various names) summarized by Suarez-Santiago & al. (2007). In the hexaploid *M. baeticum*, we found homogeneous pollen (size and color) that agrees with the regular meiosis (27 bivalents) described by Ruiz Rejon & Oliver (1978). Note that we have clearly observed numerous pollen grains germinated in anthers and on stigma of some lower buds, before the flowering. This suggests the occurrence of cleistogamy in these high polyploid and isolated French populations. In contrast, in the pentaploid *M. olivetorum*, Ruiz Rejon & Oliver (1978) detected various meiotic aberrations, which probably led to absence of sexual reproduction (Suarez-Santiago & al., 2007). According to these authors, the diploid taxa (*M. cazorlanum* C.Soriano & al., *M. atlanticum* Boiss. & Reut.) differ from all polyploid taxa in having exserted anthers (vs. included) in lower fertile flowers and many apical sterile flowers (up to 60% in total, vs. scant). These characters are clearly linked with their respective mating systems (outcrossing vs. selfing or apomixis).

Morphologically, the two related species, *M. atlanticum* (2*x*) and *M. baeticum* (6*x*), possess few bulbils (0–2), but the hexaploid taxon differs from the diploid in having included anthers, fewer sterile flowers and shorter inflorescences. The other polyploids are characterized by numerous bulbils, but *M. olivetorum* (5*x*) differs from *M. neglectum* (4*x*) with regard to much higher number of bulbils (20–50 vs. 10–30) and longer inflorescences. In these taxa, vegetative multiplication and

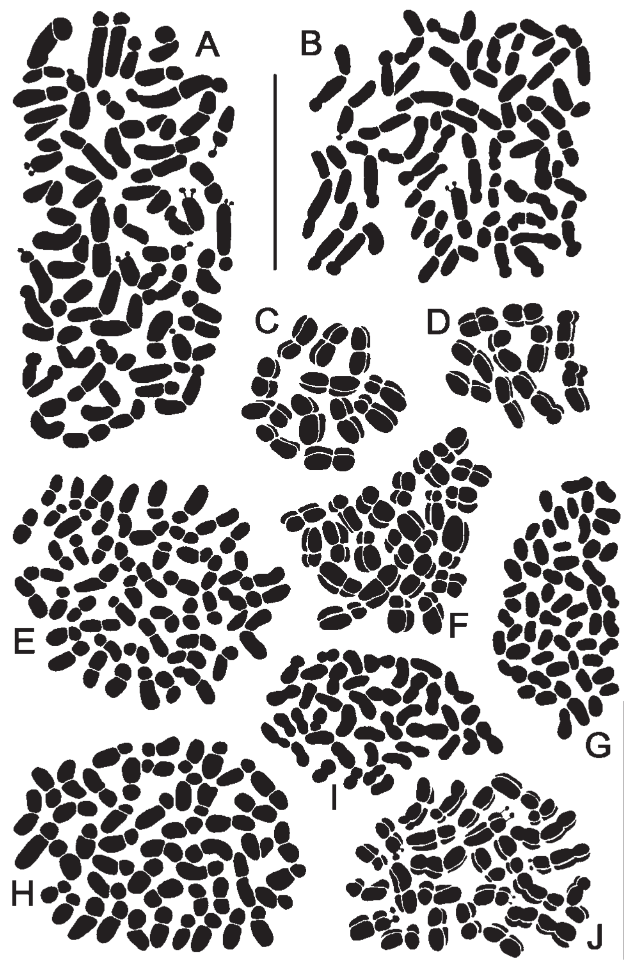


**Fig. 1.** Somatic metaphase. **A & B,** In root tips (first scale); **A,** *Muscari baeticum*, 2*n* = 54; **B,** *M. olivetorum*, 2*n* = 45; **C–J,** In ovary (second scale); *Viola biflora*, 2*n* = 12; **D,** *V. parvula*, 2*n* = 10; **E,** *V. bubanii*, 2*n* = 52; **F,** *V. cornuta*, 2*n* = 22; **G,** *V. lactea*, 2*n* = ca. 58; **H,** *V. lutea*, 2*n* = 48; **I,** *V. riviniana*, 2*n* = 40; **J,** *V. tricolor* subsp. *subalpina*, 2*n* = 26. — Scale bars = 10 µm.

agamospermy ensure the propagation, seed production, and stability of chromosome numbers.

**VIOLACEAE**

▼ *Viola biflora* L.

2*n* = 12, CHN. France, Pyrénées-Orientales, commune of Casteil, Mt Canigou, refuge of Mariaille, 1700 m, in a fir forest, near a spring, 42°29′52.7″N, 02°24′35.9″E, 9 Jun 2014, *Espeut F14-2* (MARS) [Fig. 1C].

*Viola bubanii* Timb.

2*n* = 52, CHN. France, Tarn, commune of Lacaune, Les Vidals, grassy heath, 994 m, 43°41′32.9″N, 02°43′58.4″E, 23 Apr 2015, *Espeut F15-4* (MARS) [Fig. 1E].

In this locality, *V. bubanii* grew alone, without *V. tricolor* L. Our previous chromosome number for "*V. bubanii*": 2*n* = 42–44 from Griffoulou (Verlaque & Espeut, 2007), in fact corresponds to the hybrid *V. bubanii* × *V. tricolor*. In this locality, these two species were profuse and their hybrids frequent. Our present count for *V. bubanii* (2*n* = 52, from the Mt Lacaune) is in agreement with the previous report from Mt Né, locus classicus (Aldasoro & Lainz, 1992). This locality is situated in the northernmost part of the range of this Pyrenean-Cantabrian species.

▼ *Viola cornuta* L.

2*n* = 22, CHN. France, Pyrénées-Orientales, commune of Puyvalador, between Fontrabiouse village and the lake of Puyvalador, grassland, 1474 m, 42°38′21.2″N, 02°06′24.1″E, 18 May 2014, *Espeut F14-3* (MARS) [Fig. 1F].

This locality is situated in the easternmost part of the range of this Pyrenean-Cantabrian species.

*Viola lactea* Sm.

2*n* = c. 58, CHN. France, Aude, commune of Massac, Mt Le Ramaret, near the Cédeillan Pass, 640 m, *Calluna* heathland, 42°54′5.6''N, 02°32′55″E, 16 May 2007, *Espeut F07-6* (MARS) [Fig. 1G].

Discovered in 2006 by D. Barreau, this locality is the easternmost known for this Atlantic species.

*Viola lutea* Huds.

2*n* = 50, CHN. France, Lozère, commune of Nasbinals, SW of the village, granitic plateau of Aubrac, meadow, 1280 m, 44°38′39″N, 03°00′41.6″E, 30 May 2014, *Espeut F14-5* (MARS).

2*n* = 48, CHN. France, Aveyron, commune of Laguiole, Mt Puech-de-Suquet, grazed moor, 1230 m, 44°40′51.8″N, 02°53′40.8″E, 30 May 2014, *Espeut F14-4* (MARS) [Fig. 1H].

This latter locality is situated at the SW limit of the specific range of this European orophyte species. Similar counts have been found in Czech Republic (Krahulcová & al., 1996), at the NE limit of the range.

▼ *Viola parvula* Tineo

2*n* = 10, CHN. France, Pyrénées-Orientales, commune of Nohèdes, shrubland with *Cytisus oromediterraneus* Rivas-Mart. & al., 1450 m, 42°37′43.7″N, 02°14′46.1″E, 11 May 2005, *Espeut F05-54* (MARS) [Fig. 1D].

This locality is situated at the NW limit of the specific area of this circum-Mediterranean annual orophyte.

▼ *Viola riviniana* Rchb.

2*n* = 40, CHN. France, Pyrénées-Orientales, commune of *Casteil*, Mt *Canigou*, refuge of *Mariailles*, forest edges, 1720 m, 42°30′01″N, 02°24′25.5″E, 9 Jun 2014, *Espeut F14-1* (MARS) [Fig. 1I].

▼ *Viola tricolor* subsp. *subalpina* (Latourr.) Gaudin

2*n* = 26, CHN. France, Pyrénées-Orientales, commune of Nohèdes, shrubland with *Cytisus oromediterraneus* Rivas-Mart. & al., 1450 m, 42°37′43.7″N, 02°14′46.1″E, 11 May 2005, *Espeut F05-53* (MARS) [Fig. 1J].

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* First chromosome count for the species.
** New chromosome report (cytotype) for the species.
▼ First chromosome count for an Indian accession.

The study was supported by financial grant under IPLS Project of DBT (BT/PR 4548/INF/22/146/2012) and UGC-RGNF (F1-17.1/2011-12/RGNF-SC-PUN-11224).

**BRASSICACEAE**

** *Farsetia hamiltonii* Royle

*n* = 18, CHN. India, Rajasthan, Jodhpur, Khema Ka Kuan, 25°44′N, 73°20′E, 400 m, along roadside, 15 Mar 2014, *K. Kaur 31252* (PUN 59676) [Fig. 1A].

Previously, tetraploid cytotype with 2*n* = 24 was reported for this species from India (Sharma & Dhakre, 1981).

**CAPPARACEAE**

▼ *Dipterygium glaucum* Decne.

*n* = 11, CHN. India, Rajasthan, Raisinghnagar, 29°53′N, 73°44′E, 160 m, near a stream, 3 Sep 2011, *K. Kaur 31274* (PUN 59681) [Fig. 1B].

This count agrees with *n* = 11 (Khatoon & Ali, 1993) previously reported for this species from outside of India.

**FABACEAE**

▼ *Taverniera cuneifolia* (Roth) Arn.

*n* = 8, CHN. India, Rajasthan, Pali, 25°44′N, 73°20′E, 230 m, in plain dry field, 17 Mar 2014, *K. Kaur 31253* (PUN 59677) [Fig. 1C].

This report agrees with the previous one (2*n* = 16) from outside of India (Khatoon & Ali, 1991; Jahan & al., 1994).

** *Tephrosia wallichii* Graham ex Fawcett & Rendle

*n* = 22; CHN. India, Rajasthan, Pali, Rajgo, 25°44′N, 73°20′E, 240 m, along roadside, 16 Mar 2014, *K. Kaur 31262* (PUN 59678) [Fig. 1D].

Previously, diploid chromosome number 2*n* = 22 was reported for this species from India (Singh & Yadava, 1978).

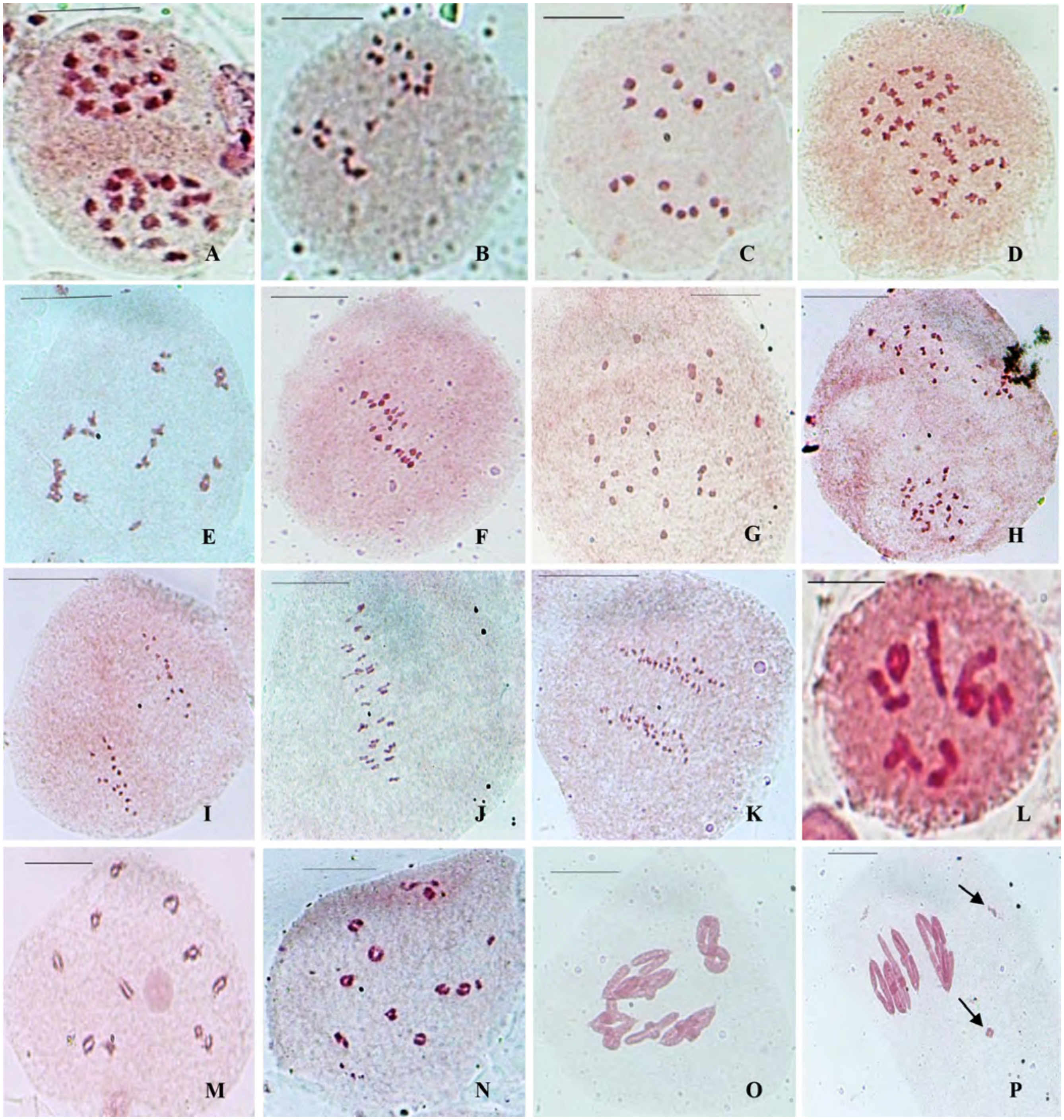


**Fig. 1. A,** *Farsetia hamiltonii*, PMC at Anaphase I, *n* = 18 (PUN 59676); **B,** *Dipterygium glaucum*, PMC at Anaphase I, *n* = 11 (PUN 59681); **C,** *Taverniera cuneifolia*, PMC at Anaphase I, *n* = 8 (PUN 59677); **D,** *Tephrosia wallichii*, PMC at Metaphase II, *n* = 22 (PUN 59678); **E,** *Abelmoschus moschatus*, PMC at Metaphase I, *n* = 18 (PUN 59671); **F,** *Abutilon ramosum*, PMC at Metaphase I, *n* = 21 (PUN 59672); **G,** *Hibiscus lobatus*, PMC at Metaphase I, *n* = 36 (PUN 59680); **H,** *Oxalis corymbosa*, PMC at Anaphase I, *n* = 28 (PUN 59673); **I,** *Argemone mexicana*, PMC at Anaphase I, *n* = 14 (PUN 59106); **J,** *Argemone mexicana*, PMC at Metaphase I, *n* = 28 (PUN 59103); **K,** *Melhania magnifolia*, PMC at Anaphase I, *n* = 30 (PUN 59670) **L,** *Triumfetta rhomboidea*, PMC at Metaphase I, *n* = 8 (PUN 58591); **M,** *Fagonia cretica*, PMC at Diakinesis, *n* = 11 (PUN 59432); **N,** *Fagonia schweinfurthii*, PMC at Metaphase I, *n* = 11 (PUN 59682); **O,** *Peganum harmala*, PMC at Metaphase I, *n* = 6 (PUN 59435); **P,** *Peganum harmala*, PMC at Metaphase I, *n* = 6+2B (arrows). — Scale bars = 10 µm.

## MALVACEAE

** *Abelmoschus moschatus* Medik.

*n* = 18, CHN. India, Rajasthan, Udaipur, Near Fatehsagar Lake, 25°44′N, 73°20′E, 580 m, near lake moist area, 15 Sep 2013, *K. Kaur 31230* (PUN 59671) [Fig. 1E].

Previously 2*n* = 72 was reported for this species from outside of India (Cheng & Tsai, 1999).

* *Abutilon ramosum* Guill. & Perr.

*n* = 21, CHN. India, Rajasthan, Udaipur, Gulab Bagh, 24°34′N, 73°41′E, 591 m, 12 Sep 2013, *K. Kaur 31231* (PUN 59672) [Fig. 1F].

*Hibiscus lobatus* (Murray) Kuntze

*n* = 36, CHN. India, Rajasthan, Udaipur, Saheliyon Ki Bari, 24°58′N, 73°50′E, 598 m, on moist and shady place, 12 Sep 2013, *K. Kaur 31273* (PUN 59680) [Fig. 1G].

This report agrees with the previous one from India (Munirajappa & Krishnappa, 1989).

## OXALIDACEAE

** *Oxalis corymbosa* DC.

*n* = 28, CHN. India, Rajasthan, Udaipur, near Gulab Bagh, 24°34′N, 73°41′E, 590 m, on moist and shady place, 14 Sep 2013, *K. Kaur 31242* (PUN 59673) [Fig. 1H].

Previously 2*n* = 14 (Xu & al., 1992) from outside of India, 2*n* = 28 (Roy & al., 1988) and 2*n* = 22, 30 (Chatterjee & Sharma, 1970) from India were reported for this species.

## PAPAVERACEAE

*Argemone mexicana* L.

*n* = 14, CHN. India, Rajasthan, Mount Abu, Nakki Lake, 24°59′N, 72°70′E, 1220 m, on moist and shady place, 15 Dec 2012, *K. Kaur 31212* (PUN 59106) [Fig. 1I].

** *n* = 28, CHN. India, Rajasthan, Churu, Chappar, near lake, 27°79′N, 74°43′E, 302 m, 12 Nov 2012, *K. Kaur 31209* (PUN 59103) [Fig. 1J].

Previously tetraploid cytotype with 2*n* = 28 was reported for this species from India (Trivedi & Trivedi, 1992) and outside of India (Safonova, 1991). Besides this, chromosome number 2*n* = 112 was also reported (Diers, 1961).

## STERCULIACEAE

* *Melhania magnifolia* Blatt. & Hallb.

*n* = 30, CHN. India, Rajasthan, Udaipur, Monsoon Palace, in shady and moist place, 24°34′N, 73°41′E, 910 m, 18 Sep 2013, *K. Kaur 31226* (PUN 59670) [Fig. 1K].

## TILIACEAE

** *Triumfetta rhomboidea* Jacq.

*n* = 8, CHN. India, Rajasthan, Jhalawar, 24°35′N, 76°10′E, 469 m, in moist place, 9 Apr 2012, *K. Kaur 31206* (PUN 58591) [Fig. 1L].

Previously tetraploid chromosome number 2*n* = 32 was reported for this species from outside of India (Paiva & Leitao, 1987) and hexaploid chromosome number 2*n* = 48 from India (Krishnappa & Munirajappa, 1980).

## ZYGOPHYLLACEAE

▼ *Fagonia cretica* L.

*n* = 11, CHN. India, Rajasthan, Jodhpur, Massuriya Hill Garden, 26°44′N, 73°20′E, 350 m, in dry desert area, 14 Mar 2014, *K. Kaur 31219* (PUN 59432) [Fig. 1M].

Previously 2*n* = 18, 20, 22 (Baquar, 1967) was reported for this species from outside of India and 2*n* = 20 from India (Bhansali & Bhandari, 1974).

▼ *Fagonia schweinfurthii* Hadidi

*n* = 11, CHN. India, Rajasthan, Sri Ganganagar, 29°90′N, 73°88′E, 165 m, along road side dry area, 4 Mar 2012, *K. Kaur 31295* (PUN 59682) [Figs. 1N].

This report agrees with the previous reported chromosome numbers 2*n* = 22 (Baquar, 1967) and 2*n* = 20, 22 (Zaidi, 2003) from outside of India.

** *Peganum harmala* L.

*n* = 6+0–2B, CHN. India, Rajasthan, Jodhpur, Khema Ka Kuan, 25°44′N, 73°20′E, 282 m, along roadside, 17 Mar 2014, *K. Kaur 31222* (PUN 59435) [Fig. 1O, P].

Previously chromosome number 2*n* = 22 and 24 (Ma & al., 1984, 1990) from outside of India and 2*n* = 24 from India (Singh, 1984) were reported for this species.

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This study was supported by the Research and Development Support Agency (project no. APVV-0320-10). The authors wish to thank The Royal Botanic Gardens, Kew (U.K.) and The National Botanic Garden of Belgium for providing seeds of *P. hieracioides* subsp. *hieracioides* (pop. LON) and (pop. BE2), respectively.

**FCM**

Propidium iodide (PI). Internal standard: To cover the entire genome size variation of the *Picris* taxa analysed, and to avoid overlap between sample and standard peaks, three different internal standards were used: *Glycine max* L. (Merr.) cv. 'Polanka' (2C DNA = 2.50 pg; Doležel & al. 1994) as a primary standard, and *Bellis perennis* L. (2C DNA = 3.76 pg) and S*olanum esculentum* L. 'Stupické polní rané' (2C = 2.07 pg) as secondary standards. The genome sizes of the secondary standards *B. perennis* and *S. esculentum* 'Stupické polní rané' were calibrated against the primary standard, based on 20 and 11 replicates, respectively, performed on different days. Diploid plants ($2n = 2x = 10$) of *P. hieracioides* L. subsp. *hieracioides*, *P. h.* subsp. *hispidissima* (Bartl.) Slovák & Jar.Kučera, *P. h.* subsp. *umbellata* (Schrank) Ces. and *P. olympica* Boiss., and one tetraploid ($2n = 4x = 20$) individual of *P. h.* subsp. *umbellata* with counted chromosomes were used as reference material for DNA ploidy inference (Suda & al., 2006) (Fig. 1A–D). The chromosome number of an assumed DNA triploid of *P. h.* subsp. *hieracioides* from Turkey (pop. IZM2, Fig. 2) was unfortunately not confirmed by direct chromosome counting, because the plant died prior to the analysis. Genome size data were obtained using a CyFlow SL cytometer (Partec GmbH, Munster, Germany) equipped with a green solid-state laser (Cobolt Samba 532 nm, 100 mW; Cobolt, Stockholm, Sweden) as the excitation source in the laboratory of flow cytometry at the Institute of Botany, Slovak Academy of Sciences (IBOT SAS), Bratislava, Slovakia. Samples of species included in the study were prepared from fresh intact leaves of individuals cultivated at the IBOT SAS following the protocol used in our previous studies (Slovák & al., 2009a, b). Plants with known chromosome numbers were analysed simultaneously with an internal standard, and the ratio of their peak positions was calculated. The absolute DNA content of individuals with unknown chromosome numbers was estimated by relating the position of their peak to the position of that of the reference standard. For each individual, three independent measurements were carried out on different days. Between-day variation caused by random instrument drift and/or non-identical sample preparation was low, as the maximum/minimum values from three repeated analyses of the same sample did not exceed the two-percent threshold. To confirm the reliability of the estimated C-values (Greilhuber & al., 2005), simultaneous analyses of selected samples differing in genome size by more than 4.5% were performed (not shown). Genome size values presented herein were estimated using a flow cytometer at the IBOT SAS. By contrast, data published in our previous studies were obtained using a different flow cytometer in the cytometry lab at the Department of Botany, Faculty of Science, Charles University, Prague, Czech Republic (Slovák & al., 2009a, b). This might potentially cause problems in comparative analyses of all the genome size datasets. Thus, to ensure comparability of genome size values that originated from different laboratories, we reanalysed individuals from populations CHRB and KOZ of *P. h. hieracioides* (pops. no. 46, 53 and 45 in Slovák & al., 2009a), and PAK and DUB of *P. h. hispidissima* (pops. PAK and DUB in Slovák & al., 2009b). Estimated 2C values presented herein fall within the genome size ranges detected in populations included in previous studies: CHRB 2.79 pg vs. 2.77–2.81 pg, KOZ 2.75–2.79 vs. 2.78–2.80 pg (cf. Slovák & al., 2009a) and DUB 3.16 pg vs. 3.22–3.25 pg, PAK 3.18 pg vs. 3.07–3.10 pg. (cf. Slovák & al., 2009b).

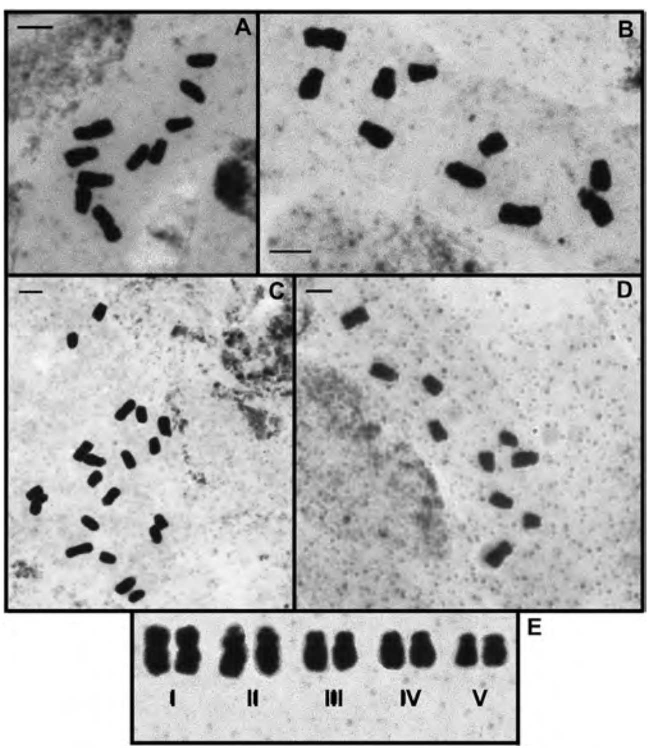


**Fig. 1.** Microphotographs of mitotic metaphases of *Picris hieracioides* subspecies and of *P. olympica*. **A,** *P. hieracioides* subsp. *hispidissima* (pop. KAR): $2n = 2x = 10$; **B,** *P. hieracioides* subsp. *umbellata* (pop. RO_11): $2n = 2x = 10$; **C**, *P. hieracioides* subsp. *umbellata* (pop. RO_11): $2n = 4x = 20$; **D,** *P. olympica* (pop. ULU): $2n = 2x = 10$; **E,** generalized karyotype characteristics of analysed *Picris* taxa; the karyotype formula is 2m+2smsat+4sm+2st. For population codes, refer to the text. — Scale bars: 4 µm.

**Direct chromosome counting**

For karyological analyses, root meristems from seedlings or from potted plants were employed. Root tips were pre-treated in a 0.002 M water solution of 8-hydroxyquinoline at 8°C for about 16 h (overnight), fixed in a 1 : 3 mixture of 98% aceticacid and 96% ethanol for 1–24 h, washed in distilled water, macerated in 1N HCl at the temperature of 60°C for 5 min and washed in distilled water. Squashes were made using the cellophane square technique (Murín, 1960). The slides were stained by a 7% solution of Giemsa Stain, Modified Solution, Fluka Analytical in distilled water, dried and observed microscopically in a drop of immersion oil.

**Karyotype estimation and standardized chromosome length measurements**

Suitable c-metaphase plates for karyotype analyses, that is, metaphase plates with well-spread chromosomes in which primary and secondary constrictions were unambiguously detectable, were selected. Ten suitable c-metaphase plates were photographed (Leica DM 2500 equipped with a DFC 290 HD camera controlled by the Leica application suite v.3). For each specimen, individual chromosomes were measured, and chromosome length and arm ratio were calculated. The classification of chromosome types follows Levan & al. (1965). For standardized total chromosome length determination (Mártonfiová, 2013), special c-metaphase plates were selected on which the chromosomes were contracted as much as possible, retaining all the karyotype characteristics measurable without any damage by excessive pre-treatment.

**COMPOSITAE**

*Picris hieracioides* L. subsp. *hieracioides*

The coefficients of variation of $G_1$ peaks of *P. h.* subsp. *hieracioides* samples and the internal standard were 1.53%–4.00% (mean 2.90%) and 1.52%–3.85% (mean 2.93%), respectively. The mean 2C-values for analysed DNA diploids ranged from 2.10 to 2.93 pg, and the 2C-value for the analysed DNA triploid individual was 3.83 pg. The greatest divergence in genome size between accessions of *P. h.* subsp. *hieracioides* was 45.31%.

2*n* = 2*x* = 10, CHN. Great Britain, England, Greater London, 51°30′19″N, 00°07′26″W, 75 m, 22 Oct 1985, *G.J. Cunnel LON1* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.11–2.16 pg, FCM. Belgium, Vlaams-Brabant, Wemmel, 50°54′25″N, 04°18′13″E, 43 m, Oct 2011, *S. Godefroid*, *BE2–1*, *S. Godefroid BE2–2*, *S. Godefroid BE2–3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.30–2.37 pg, FCM. Bosnia and Herzegovina, Višegrad, Meremišlje, 43°44′36″N, 19°13′17″E, 360 m, 30 Jul 2009, *M. Slovák & J. Kučera BOS1–1*, *M. Slovák & J. Kučera BOS1–2*, *M. Slovák & J. Kučera BOS1–3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.81–2.87 pg, FCM. Bulgaria, Chaskovo, Klokotnitsa, 41°58′43″N, 25°31′56″E, 185 m, 15 Jul 2011, *M. Slovák & J. Kučera BG1–1*, *M. Slovák & J. Kučera BG1–2*, *M. Slovák & J. Kučera BG1–4* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.85–2.94 pg, FCM. Bulgaria, Burgas, Malko Tarnovo, 41°58′20″N, 27°29′09″E, 541 m, 20 Jul 2011, *M. Slovák & J. Kučera BG2–1*, *M. Slovák & J. Kučera BG2–2*, *M. Slovák & J. Kučera BG2–4* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.56–2.65 pg, FCM. Bulgaria, Burgas, Tzarevo, 42°10′09″N, 27°50′16″E, 44 m, 21 Jul 2011, *M. Slovák & J. Kučera BG3–2*, *M. Slovák & J. Kučera BG3–5*, *M. Slovák & J. Kučera BG3–5a* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.74–2.79 pg, FCM. Bulgaria, Targovište, Razbojna, 43°12′03″N, 26°30′42″E, 269 m, 21 Jul 2011, *M. Slovák & J. Kučera BG6–2*, *M. Slovák & J. Kučera BG6–2a*, *M. Slovák & J. Kučera BG6–4* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.39–2.45 pg, FCM. Czech Republic, South Moravia region, Břeclav, 48°46′51″N, 16°54′19″E, 166 m, 21 Sep 2011, *M. Slovák & J. Kučera CZ1–2*, *M. Slovák & J. Kučera CZ1–4*, *M. Slovák & J. Kučera CZ1–5* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.20–2.73 pg, FCM. Czech Republic, South Moravia region, Rosice, 49°11′24″N, 16°25′14″E, 368 m, 21 Sep 2011, *M. Slovák & J. Kučera CZ2–3*, *M. Slovák & J. Kučera CZ2–3a*, *M. Slovák & J. Kučera CZ2–4* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.34–2.64 pg, FCM. Czech Republic, Pardubice region, Chrudim, 49°57′48″N, 15°46′58″E, 270 m, 21 Sep 2011, *M. Slovák & J. Kučera CZ3–3*, *M. Slovák & J. Kučera CZ3–4*, *M. Slovák & J. Kučera CZ3–5* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.75–2.79 pg, FCM. Czech Republic, Ústí nad Labem region, Žatec, 50°20′44″N, 13°32′47″E, 238 m, 22 Sep 2011, *M. Slovák & J. Kučera CZ4–2*, *M. Slovák & J. Kučera CZ4–3*, *M. Slovák & J. Kučera CZ4–4* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.30–2.37 pg, FCM. Germany, Sachsen, Pflug, 50°59′18″N, 12°36′29″E, 242 m, 22 Sep 2011, *M. Slovák & J. Kučera DE1–2*, *M. Slovák & J. Kučera DE1–4*, *M. Slovák & J. Kučera DE1–5* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.33–2.42 pg, FCM. Germany, Sachsen, Leipzig, 51°15′06″N, 12°18′33″E, 98 m, 22 Sep 2011, *M. Slovák & J. Kučera DE2–1*, *M. Slovák & J. Kučera DE2–1a*, *M. Slovák & J. Kučera DE2–3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.36–2.40 pg, FCM. Germany, Sachsen-Anhalt, Magdeburg, 52°03′39″N, 11°35′12″E, 84 m, 22 Sep 2011, *M. Slovák*

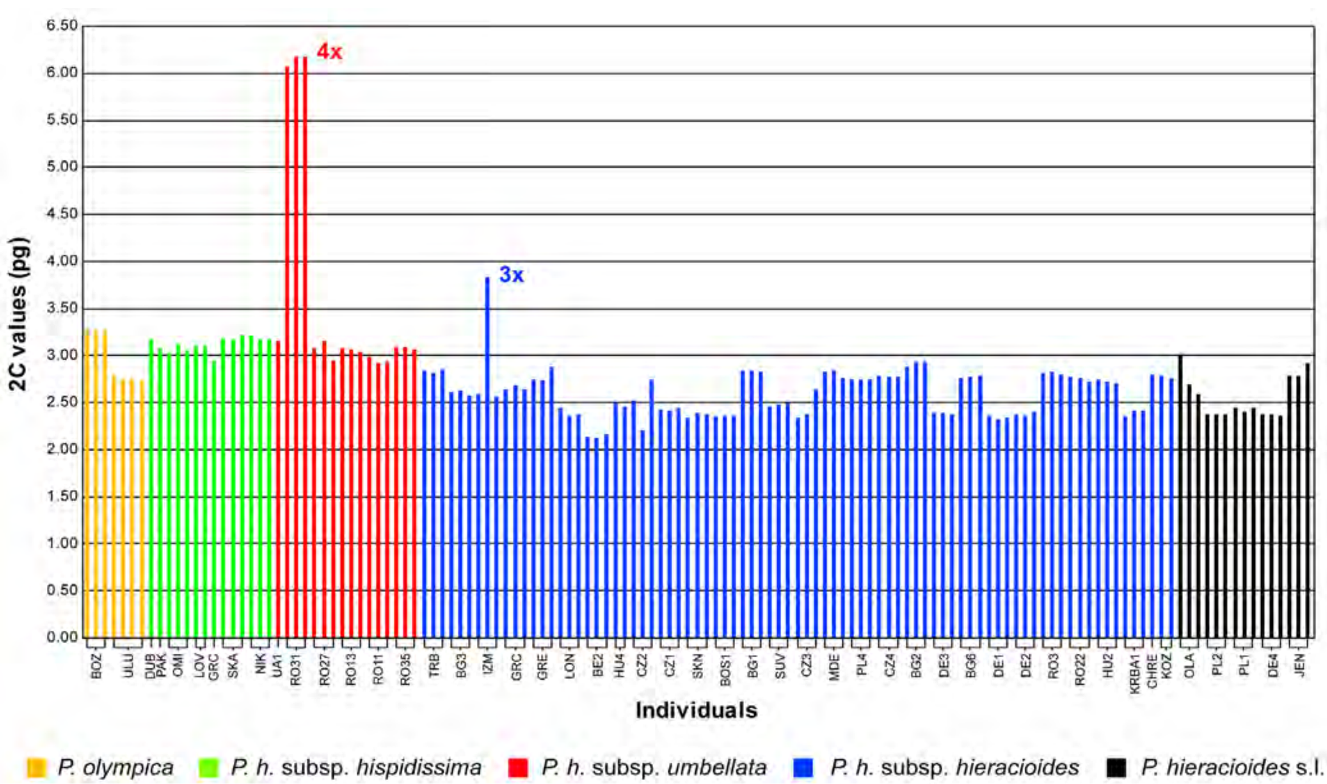


**Fig. 2.** Graph displaying genome size variation of analysed *Picris* taxa.

*& J. Kučera DE3–1*, *M. Slovák & J. Kučera DE3–1a*, *M. Slovák & J. Kučera DE3–3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.32–2.43 pg, FCM. Germany, Brandenburg, Kreis Barnim, Barnimer Heide, 52°51′20″N, 13°42′27″E, 31 m, 22 Sep 2011, *M. Slovák & J. Kučera KRBA1–1*, *M. Slovák & J. Kučera KRBA1–2*, *M. Slovák & J. Kučera KRBA1–3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.35–2.44 pg, FCM. Great Britain, England, Greater London, 51°30′19″N, 00°07′26″W, 75 m, 22 Oct 1985, *G.J. Cunnel LON1*, *G.J. Cunnel LON2*, *G.J. Cunnel LON3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.60–2.69 pg, FCM. Greece, Makedonia Thraki, Chamokerassa, 41°11′47″N, 24°23′48″E, 303 m, 19 Jun 2011, *M. Slovák, J. Kučera & A. Guttová GRC1*, *M. Slovák, J. Kučera & A. Guttová GRC2*, *M. Slovák, J. Kučera & A. Guttová GRC3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.73–2.78 pg, FCM. Greece, Makedonia Thraki, Mesorachi, 41°00′59″N, 23°50′55″E, 230 m, 19 Jun 2011, *M. Slovák, J. Kučera & A. Guttová GRE1*, *M. Slovák, J. Kučera & A. Guttová GRE2*, *M. Slovák, J. Kučera & A. Guttová GRE3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.70–2.75 pg, FCM. Hungary, Borsod-Abaúj-Zemplén, Cigánd, 48°16′07″N, 21°56′04″E, 94 m, 2 Aug 2010, *M. Slovák, J. Kučera & P. Repa HU2–1*, *M. Slovák, J. Kučera & P. Repa HU2–2*, *M. Slovák, J. Kučera & P. Repa HU2–3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.42–2.49 pg, FCM. Hungary, Komárom-Esztergom, Tata, 47°38′08″N, 18°14′17″E, 153 m, 24 Jun 2011, *M. Slovák, J. Kučera & A. Guttová HU4–1*, *M. Slovák, J. Kučera & A. Guttová HU4–2* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.74–2.85 pg, FCM. FYROM Macedonia, Ohrid, Dolno Konjsko, 41°03′23″N, 20°48′09″E, 703 m, 21 Jul 2010, *M. Slovák, J. Kučera & A. Guttová MDE1*, *M. Slovák, J. Kučera & A. Guttová MDE2*, *M. Slovák, J. Kučera & A. Guttová MDE3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.73–2.75 pg, FCM. Poland, Województwośląskie, Mykanów, 50°54′31″N, 19°12′24″E, 236 m, 24 Sep 2011, *M. Slovák & J. Kučera PL4–3*, *M. Slovák & J. Kučera PL4–3a*, *M. Slovák & J. Kučera PL4–4* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.79–2.82 pg, FCM. Romania, Gorj, Baia de Fier, 45°08′42″N, 23°46′28″E, 539 m, 4 Aug 2010, *M. Slovák, J. Kučera & P. Repa RO3–1*, *M. Slovák, J. Kučera & P. Repa RO3–2*, *M. Slovák, J. Kučera & P. Repa RO3–3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.72–2.78 pg, FCM. Romania, Harghita, near Tăureni, 46°15′54″N, 25°14′54″E, 457 m, 8 Aug 2010, *M. Slovák, J. Kučera & P. Repa RO22–1*, *M. Slovák, J. Kučera & P. Repa RO22–2*, *M. Slovák, J. Kučera & P. Repa RO22–3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.44–2.52 pg, FCM. Republic of Serbia, Šumadijai zapadna Srbija, Suvobor, 44°07′28″N, 20°15′56″E, 694 m, 19 Jul 2009, *M. Slovák & J. Kučera SUV1–1*, *M. Slovák & J. Kučera SUV1–2*, *M. Slovák & J. Kučera SUV1–3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.75–2.79 pg, FCM. Slovakia, Štiavnické vrchy Mts.,village of Kozelník, 48°33′43″N, 19°00″30″E, 275 m, 12 Aug 2011, *M. Slovák & J. Kučera KOZ1*, *M. Slovák & J. Kučera KOZ2*, *M. Slovák & J. Kučera KOZ3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.33–2.40 pg, FCM. Sweden, Skåne, Karpalund, 56°02′26″N, 14°15′32″E, 5 m, Aug 2011, *U.-G. Andersson, Å. Svensson & T. Tyler SKN1*, *U.-G. Andersson, Å. Svensson & T. Tyler SKN2*, *U.-G. Andersson, Å. Svensson & T. Tyler SKN3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.54–2.58 pg, FCM. Turkey, Denizli, Babadag Mt., 37°45′51″N, 28°51′32″E, 1412 m, 17 Jul 2010, *M. Slovák & J. Kučera IZM1*, *M. Slovák & J. Kučera IZM3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.79–2.88 pg, FCM. Turkey, Eskişehir, Bozuk Satih, 39°49′08″N, 30°11′52″E, 829 m, 16 Jul 2011, *M. Slovák & J. Kučera TRB1*, *M. Slovák & J. Kučera TRB2*, *M. Slovák & J. Kučera TRB3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.79 pg FCM. Ukraine, Khmel'nyts'ka oblast', Chrebtyev, 48°37′33″N, 27°14′25″E, 260 m, 20 Jul 2007, *I. Hodálová & P. Mereďa CHRE1* (SAV).

2*n* ~ 3*x* ~ 15, 2C = 3.83 pg, FCM. Turkey, Denizli, Babadag Mt., 37°45′51″N, 28°51′32″E, 1412 m, 17 Jul 2010, *M. Slovák & J. Kučera IZM2* (SAV).

*Picris hieracioides* subsp. *hispidissima* (Bartl.) Slovák & Jar. Kučera

The coefficients of variation of $G_1$ peaks of *P. h.* subsp. *hispidissima* samples and the internal standard were 1.99%–3.67% (mean 2.73%) and 2.05%–4.59% (mean 2.96%), respectively. The mean 2C-values for analysed individuals ranged from 2.94 to 3.23 pg. The greatest divergence in genome size between accessions of *P. h.* subsp. *hispidissima* was 8.98%.

2*n* = 2*x* = 10, CHN. Croatia, Dubrovačko-neretvanska županija, Dubrovnik, 42°38′36″N, 18°07′18″E, 145 m, 12 Jun 2011, *M. Slovák, J. Kučera & A. Guttová DUB8* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 3.16 pg, FCM. Croatia, Dubrovačko-neretvanska županija, Dubrovnik, 42°38′36″N, 18°07′18″E, 145 m, 12 Jun 2011, *M. Slovák, J. Kučera & A. Guttová DUB8* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.95 pg, FCM. Croatia, Zadarska županija, Gračac, 44°15′52″N, 16°00′32″E, 756 m, 11 Jun 2011, *M. Slovák, J. Kučera & A. Guttová GRC6* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 3.08 pg, FCM. Croatia, Ličko-senjska županija, Velika Paklenica valley, 44°17′00″N, 15°27′00″E, 30 m, 11 Jun 2011, *M. Slovák, J. Kučera & A. Guttová PAK5* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.99–3.15 pg, FCM. Croatia, Primorsko-goranska županija, Island Krk, Omišalj, 45°14′15″N, 14°33′24″E, 53 m, 10 Jun 2011, *M. Slovák, J. Kučera & A. Guttová OMI5*, *M. Slovák, J. Kučera & A. Guttová OMI10*, *M. Slovák, J. Kučera & A. Guttová OMI10a* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 3.07–3.13 pg, FCM. Montenegro, Cetinje, Cetinje, 42°24′29″N, 18°46′45″E, 485 m, 13 Jun 2011, *M. Slovák, J. Kučera & A. Guttová LOV3*, *M. Slovák, J. Kučera & A. Guttová LOV3a* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 3.12–3.23 pg, FCM. Montenegro, Bar, Virpazar, 42°13′46″N, 19°06′14″E, 107 m, 13 Jun 2011, *M. Slovák, J. Kučera & A. Guttová SKA8*, *M. Slovák, J. Kučera & A. Guttová SKA9*, *M. Slovák, J. Kučera & A. Guttová SKA10* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 3.13–3.23 pg, FCM. Montenegro, Danilovgrad, between Kujava and Cerovo, 42°36′27″N, 19°01′53″E, 185 m, 14 Jun 2011, *M. Slovák, J. Kučera & A. Guttová NIK1*, *M. Slovák, J. Kučera & A. Guttová NIK2*, *M. Slovák, J. Kučera & A. Guttová NIK8* (SAV).

*Picris hieracioides* subsp. *umbellata* (Schrank) Ces.

The coefficients of variation of $G_1$ peaks of *P. h.* subsp. *umbellata* samples and the internal standard were 1.56%–3.83% (mean 2.84%) and 1.67%–3.66% (mean 2.86%), respectively. The mean 2C-values for DNA diploids ranged from 2.90 to 3.17 pg, and 2C-values for DNA tetraploids ranged from 6.06 to 6.20 pg. The greatest divergence in genome size within *P. h.* subsp. *umbellata* reached 8.52% in diploids and 2.26% in tetraploids.

2*n* = 2*x* = 10, CHN. Romania, Vâlcea, Vioneasa, 45°24′22″N, 23°59′27″E, 977 m, 6 Aug 2010, *M. Slovák, J. Kučera & P. Repa RO11–1* (SAV).

2*n* = 2*x* = 10, CHN. Romania, Brașov, Măgura, 45°31′51″N, 25°17′27″E, 977 m, 6 Aug 2010, *M. Slovák, J. Kučera & P. Repa RO13–1* (SAV).

2*n* = 2*x* = 10, CHN. Romania, Harghita, Lacu Roşu, 46°46′48″N, 25°45′07″E, 1074 m, 9 Aug 2010, *M. Slovák, J. Kučera & P. Repa RO27–1* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.90–3.00 pg, FCM. Romania, Vâlcea, Vioneasa, 45°24′22″N, 23°59′27″E, 977 m, 6 Aug 2010, *M. Slovák, J. Kučera & P. Repa RO11–1*, *M. Slovák, J. Kučera & P. Repa RO11–2*, *M. Slovák, J. Kučera & P. Repa RO11–3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 3.03–3.09 pg, FCM. Romania, Brașov, Măgura, 45°31′51″N, 25°17′27″E, 977 m, 6 Aug 2010, *M. Slovák, J. Kučera & P. Repa RO13–1*, *M. Slovák, J. Kučera & P. Repa RO13–2*, *M. Slovák, J. Kučera & P. Repa RO13–3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.92–3.17 pg, FCM. Romania, Harghita, Lacu Roşu, 46°46′48″N, 25°45′07″E, 1074 m, 9 Aug 2010, *M. Slovák, J. Kučera & P. Repa RO27–1*, *M. Slovák, J. Kučera & P. Repa RO27–2*, *M. Slovák, J. Kučera & P. Repa RO27–3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 3.05–3.10 pg, FCM. Romania, Maramureş, Borşa, 47°37′11″N, 24°48′10″E, 927 m, 10 Aug 2010, *M. Slovák, J. Kučera & P. Repa RO35–1*, *M. Slovák, J. Kučera & P. Repa RO35–2*, *M. Slovák, J. Kučera & P. Repa RO35–3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 3.16 pg FCM. Ukraine, Lvivská oblast, Lishnya, 49°25′17″N, 23°26′04″E , 313 m, 17 Aug 2011, *M. Slovák & J. Kučera UA1–1* (SAV).

2*n* = 4*x* = 20, CHN. Romania, Suceava, Sunători, 47°23′05″N, 25°28′38″E, 784 m, 10 Aug 2010, *M. Slovák, J. Kučera & P. Repa RO31–1* (SAV).

2*n* ~ 4*x* ~ 20, 2C = 6.06–6.20 pg, FCM. Romania, Suceava, Sunători, 47°23′05″N, 25°28′38″E, 784 m, 10 Aug 2010, *M. Slovák, J. Kučera & P. Repa RO31–1*, *M. Slovák, J. Kučera & P. Repa RO31–2*, *M. Slovák, J. Kučera & P. Repa RO31–3* (SAV).

*Picris hieracioides* s.l.

Populations with uncertain taxonomic status characterized by intermediate morphology between *P. h.* subsp. *umbellata* and *P. h.* subsp. *hieracioides.* It was not possible to assign them unambiguously to particular subspecies (cf. Slovák & al., 2009a). The coefficients of variation of $G_1$ peaks of *P. hieracioides* s.l. samples and the internal standard were 2.31%–3.78% (mean 3.07%) and 2.15%–3.85% (mean 3.07%), respectively. The mean 2C-values for analysed individuals ranged from 2.34 to 3.03 pg. The greatest divergence in genome size between accessions of *P. hieracioides* s.l. was 22.77%.

2*n* ~ 2*x* ~ 10, 2C = 2.34–2.39 pg, FCM. Germany, Mecklenburg-Vorpommern, Wismar, 53°53′44″N, 11°29′13″E, 12 m, 22 Sep 2011, *M. Slovák & J. Kučera DE4–2*, *M. Slovák & J. Kučera DE4–2a*, *M. Slovák & J. Kučera DE4–3* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.76–2.93 pg, FCM. Germany, Thüringen, Wölnitz, 50°54′18″N, 11°35′53″E, 174 m, 12 Aug 2011, *Carsten J. Löser JEN1*, *Carsten J. Löser JEN2*, *Carsten J. Löser JEN2a* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.39–2.47 pg, FCM. Poland, Województwo zachodnio pomorskie, Płocin, 53°51′42″N, 14°33′26″E, 21 m, 23 Sep 2011, *M. Slovák & J. Kučera PL1–3*, *M. Slovák & J. Kučera PL1–3a*, *M. Slovák & J. Kučera PL1–5* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.35–2.40 pg, FCM. Poland, Województwo kujawsko-pomorskie, Świecie, 53°23′20″N, 18°24′30″E, 20 m, 24 Sep 2011, *M. Slovák & J. Kučera PL2–1*, *M. Slovák & J. Kučera PL2–2*, *M. Slovák & J. Kučera PL2–5* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 2.56–3.03 pg, FCM. Sweden, Öland, Sandvik 57°04′36″N, 16°51′35″E, 7 m, Aug 2011, *T. Tyler OLA1*, *T. Tyler OLA2*, *T. Tyler OLA3* (SAV).

*Picris olympica* Boiss.

The coefficients of variation of $G_1$ peaks of *P. olympica* samples and the internal standard were 2.24%–4.90% (mean value 3.33%) and 3.08%–4.95% (mean value 3.94%), respectively. The mean 2C-values for analysed individuals ranged between 2.72 and 3.32 pg. The greatest divergence in genome size between accessions of *P. olympica* was 18.07%.

2*n* = 2*x* = 10, CHN. Turkey, Izmir, Boz Dağlari Mts., 38°19′50″N, 28°06′29″E, 1677 m, 18 Jul 2011, *M. Slovák & J. Kučera BOZ1* (SAV).

2*n* = 2*x* = 10, CHN. Turkey, Bursa, Uludağ Mts., 40°05′35″N, 29°07′52″E, 2059 m, 16 Jul 2011, *Slovák & J. Kučera ULU1* (SAV).

2*n* ~ 2*x* ~ 10, 2C = 3.24–3.32 pg, FCM. Turkey, Izmir, Boz Dağlari Mts., 38°19′50″N, 28°06′29″E, 1677 m, 18 Jul 2011, *J. Kučera & M. Slovák BOZ1*, *J. Kučera & M. Slovák BOZ2*, *J. Kučera & M. Slovák BOZ3* (SAV).

2*n* ~ 2*x* ~ 10, FCM. Turkey, Bursa, Uludağ Mts., 40°05′35″N, 29°07′52″E, 2059 m, 16 Jul 2011, *Slovák & J. Kučera ULU1* (SAV), *J. Kučera & M. Slovák ULU 2*, *J. Kučera & M. Slovák ULU 3*, *J. Kučera & M. Slovák ULU 4* (SAV).

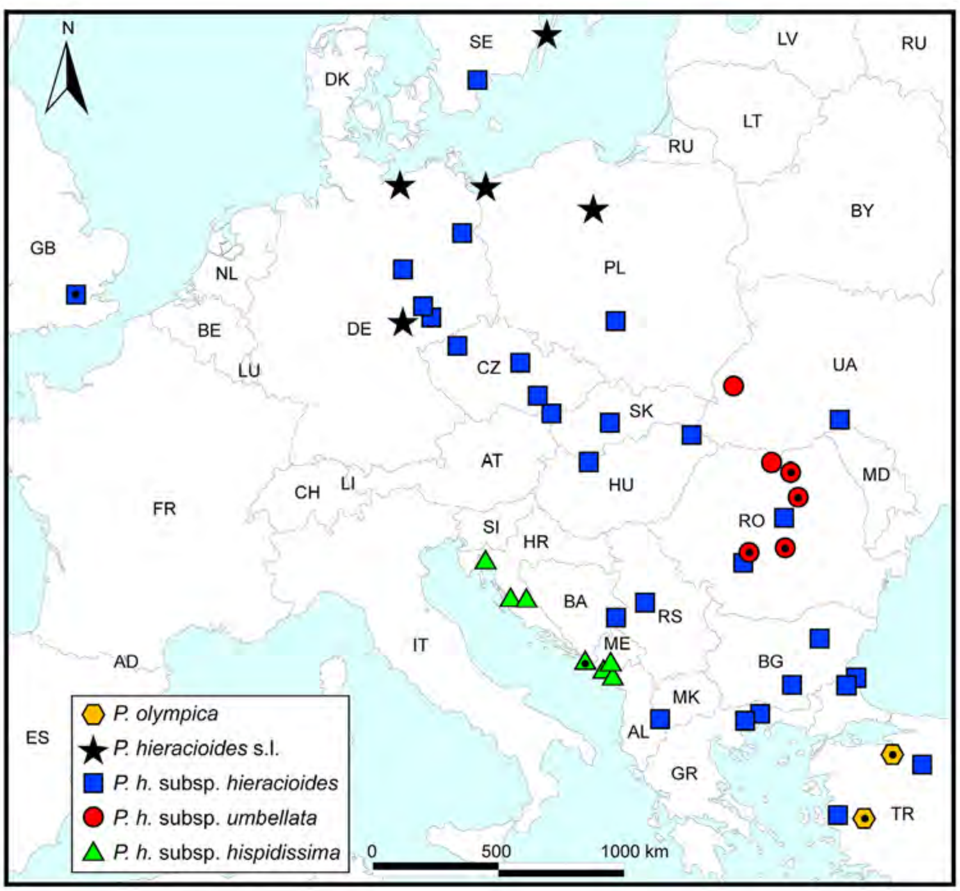


**Fig. 3.** Map displaying the geographic distribution of populations analysed karyologically within the present study. Symbols with a black dot in the centre indicate populations in which direct chromosome counting was performed.

**Table 1.** Karyotype characteristics of taxa under study.

| | Chromosome pair (AR/RL) | | | | |
|---|---|---|---|---|---|
| Taxon | I | II | III | IV | V |
| *P. hieracioides* s.l. | 1.45/0.123 | 2.20/0.118 | 2.69/0.094 | 3.13/0.090 | 2.45/0.074 |
| *P. hispidissima* | 1.45/0.124 | 2.04/0.113 | 3.04/0.091 | 2.14/0.088 | 2.56/0.080 |
| *P. olympica* | 1.34/0.124 | 2.31/0.118 | 2.82/0.093 | 3.16/0.088 | 2.96/0.077 |

AR, arm ratio (ratio of the longer to the shorter arm); RL, relative length of chromosome (ratio of the length of one chromosome to the total length of all chromosomes).

**Notes on karyological and cytogenetic variation of analysed *Picris* taxa**

European populations of *P. hieracioides* s.l. and *P. hispidissima* (Bartl.) W.D.J.Koch have been reported to be diploids with $2n = 2x = 10$ (Slovák & al., 2007, 2009a, b). Rare DNA triploids ($2n \sim 3x \sim 10$) of *P. hieracioides* s.l. that originated from the Western Carpathians were detected using propidium iodide flow cytometry (Slovák & al., 2009a). Furthermore, extraordinary infraspecific genome size variation ranging from 2C = 2.26 to 3.11 pg (1.37-fold variation) was uncovered within two ecologically and geographically largely allopatric morphological races of *P. hieracioides*, otherwise referred to as the "Lower altitude" and "Higher altitude" morphotypes (Slovák & al., 2009a). A moderate level of genome size variation, ranging from 2.96 to 3.24 pg (1.12-fold variation), was also detected in the closely related Balkan endemic *P. hispidissima* (Slovák & al., 2009b). Based on comprehensive taxonomic revisions, both morphotypes of *P. hieracioides* as well as *P. hispidissima* were elevated to the subspecific level of *P. hieracioides* (Slovák & al., 2012, 2014). Genome size variation of the nominate subspecies ranged from 2.26 to 2.79 pg (1.23-fold variation), while populations of *P. h.* subsp. *umbellata* harboured somewhat smaller genome size variation with 2C = 2.73–3.11 pg (1.14-fold variation; Slovák & al., 2009a).

We attempted to fill the gap in the knowledge of infraspecific genome size variation within populations of *P. hieracioides* in geographic regions not included in our previous studies. In particular, we studied populations of *P. h.* subsp. *hieracioides* and *P. h.* subsp. *umbellata* from NW and SE Europe and from the entire distribution range of *P. h.* subsp. *hispidissima* (Fig. 3). Finally, two populations of the higher mountain species *P. olympica*, which is an endemic of Asia Minor (Slovák & al., 2014), were analysed karyologically for the first time (Figs. 1D, 2, 3).

Both karyological and cytogenetic analyses showed that almost all populations of analysed *Picris* taxa, including *P. olympica*, are diploids with $2n = 2x = 10/2n \sim 2x \sim 10$ (Figs. 1A–E, 2). This is in agreement with all previous records (Slovák & al., 2007, 2009a, b and references therein). Two exceptions were found, however. A single individual of *P. h.* subsp. *hieracioides* from Turkey (IZM2, Fig. 2) had a 2C genome size of 3.83 pg. This value corresponds to the triploid DNA ploidy level ($2n \sim 3x \sim 15$), but it was unfortunately not accompanied by an exact chromosome count. Besides this, the absolute DNA content of three individuals from a single population of *P. h.* subsp. *umbellata* from the Romanian Carpathians (RO31_1–3) was in the range of 2C = 6.07–6.17 pg (Figs. 1C, 2, 3). These values correspond with the tetraploid level ($2n = 4x = 10$), which was confirmed also by direct chromosome counting (Fig. 1C). Tetraploids are very rare in the genus *Picris* and have been reported only for *P. japonica* Thunb. from Asia and for *P. hispanica* sampled in northern Africa (Humphries & al., 1978; Galland, 1988; Oberprieler & Vogt, 1993; Stepanov, 1994).

Infraspecific genome size variation within all three subspecies of *P. hieracioides* ranged between 2C = 2.11 and 3.23 pg (1.53-fold variation; Fig. 2). This divergence in genome size is apparently higher compared to that reported in Slovák & al. (2009a). However, the mentioned increase in genome size divergence within *P. hieracioides* can for the most part be explained by the inclusion of *P. hispidissima* under *P. hieracioides*. It turns out that previously analysed accessions of *P. h.* subsp. *hispidissima* apparently exceeded the upper limit of 2C values reported for *P. hieracioides* (Slovák & al., 2009a, b). The situation in the genome size variation of the nominate subspecies is somewhat different (Fig. 2). Compared to previously published records (2C = 2.26–2.79 pg; 1.23-fold; Slovák & al., 2009a, b), the genome size variation detected herein is higher with respect to both maximum and minimum limits (2C = 2.11–2.93 pg; 1.39-fold; Slovák & al., 2009a, b). There are no obvious differences between published data and those presented here as regards the genome size variation of *P. h.* subsp. *hispidissima* and *P. h.* subsp. *umbellata* (Fig. 2; cf. Slovák & al., 2009a, b). Interestingly, the two analysed populations of *P. olympica* apparently differ in their genome size values (1.19-fold variation in population averages; Fig. 2). Both populations occurred in the alpine zone of high and geographically distant mountain ranges in Turkey. The observed large divergence in genome size at the population level most probably reflects their long-term isolation, what is corroborated also by published genetic data (Slovák & al., 2014).

The karyotype of analysed *Picris* accessions consists of five chromosome pairs (Table 1; Fig. 1E). The two longest chromosome pairs are of a very similar length. Pair I is metacentric whereas pair II is submetacentric with a satellite, therefore these two pairs are well distinguishable. Chromosome pairs III and IV are very similar, both in chromosome length and the arm ratio, so they are difficult to distinguish. The arm ratio calculated for these chromosome pairs is often marginal for the submetacentric-subtelocentric categories. The smallest chromosome pair is submetacentric. The karyotype formula is 2m+2smsat+4sm+2st (Fig. 1E). The calculated karyotype characteristics are very similar between certain taxa and populations studied (Table 1). The greatest differences between particular analysed samples reside in the characteristics of chromosome pairs III and IV. However, these differences are most probably due to the fact that these chromosome pairs are very difficult to distinguish, rather than to variation between particular samples. In conclusion, no substantial differences were found in chromosome morphology between the

**Table 2.** Standardized chromosome length of selected accessions of analysed *Picris* taxa. For population abbreviation, see the lists above.

| Taxon | Absolute DNA content (2C in pg) | Standardized TLC |
|---|---|---|
| *P. h. hieracioides* LON1 | 2.43 | 22.66 |
| *P. h. hispidissima* DUB8 | 3.16 | 30.48 |
| *P. h. umbellata* RO11_1 | 2.98 | 24.25 |
| *P. h. umbellata* RO13_1 | 3.07 | 23.49 |
| *P. h. umbellata* RO27_1 | 3.08 | 22.70 |
| *P. olympica* ULU1 | 2.78 | 24.54 |
| *P. olympica* BOZ1 | 3.29 | 30.34 |

karyotypes studied. Only two other karyotype studies on members of the genus *Picris* have been published to date (Zhang, 1994; Zhang 1998). Both dealt with Asian taxa considered to be closely related to *P. hieracioides* s.l. (Slovák & al., 2014). The first study revealed that *P. japonica* Thunb. is diploid with $2n = 2x = 10$ and the karyotype formula 2m+6sm+2st (Zhang, 1994). Similarly, the *P. hieracioides* subsp. *japonica*, the other taxon studied, is also diploid with the karyotype formula 2m+2mt+6st (Zhang, 1998). These data are consistent with our results, and small differences are supposed to reflect the methods and accuracy of measurements rather than any dissimilarity of the karyotypes. Standardized chromosome length was measured in further populations of the taxa studied (Table 2). However, it is not consistent with DNA content measurements, suggesting that TCL is not dependent on DNA content alone.

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All materials gathered in situ in SE France and NW Italy, fixed on flowers (*F*) or seedlings (*S*) produced from seeds collected by the Conservatoire Botanique National Méditerranéen de Porquerolles, and counted by R. Verlaque; vouchers in CBNMED. CBNMED is the herbarium of the Conservatoire Botanique National Méditerranéen de Porquerolles and is stored at 34 avenue Gambetta, 83400 Hyères, France.

While SE France is a noteworthy pole of plant biodiversity, for better conservation of many rare and endemic taxa, more karyological investigations are needed.

▼ First chromosome count from French populations.

#### LAMIACEAE

▼ *Teucrium pseudochamaepitys* L.

$2n = 60$, CHN. France, Bouches-du-Rhône, Septèmes-les-Vallons, Saint-Laurent, scrubland, 250 m, 5 Jul 2014, *Pires F14-05* (CBNMED) [Fig. 1D].

In Provence, this rare W-Mediterranean species is protected at its northern limit. The previous reports have evidenced two ploidy levels which show a clear geographical structuring: $2n = 30$ from Morocco (near Fès: Bayón, 1989) and S Spain (near Sevilla: Ubera, 1983), and $2n = 60$ from N-E Spain (Madrid: Valdes-Bermejo & Sanchez Crespo, 1978; Albacete, Ciudad Real, Valencia: Bayón, 1989). Thus, our first count from France is in agreement with the chromosome number found in N-E Spain.

#### LENTIBULARIACEAE

▼ *Pinguicula hirtiflora* Ten.

$2n = 28$, CHN. France, Alpes-Maritimes, Fontan, Paganin Gorge, oozing cliff, 530 m, 21 Mar 2012, *Pires F12-19* (CBNMED) [Fig. 1A].

This species has recently been introduced in France from its original range (S & W Balkans and C & S Italy). It corresponds to a polymorphic and polyploid complex, where several distinct chromosome numbers have been found in each variety:

*P. hirtiflora* Ten. var. *hirtiflora*: $2n = 16$ from Italy and Greece (Honsell, 1959; Contandriopoulos & Quézel, 1974), and $2n = 28$ from Cyprus, Italy and Albania (Mikeladse & Casper, 1997; Casper & Stimper, 2006).

*P. hirtiflora* var. *louisii* (Markgr.) Ernst: $2n = 24$ from Greece (Contandriopoulos & Quézel, 1974); $2n = 27$, 28 from Greece and

Italy (Strid & Franzén, 1981; Mikeladse & Casper, 1997; Peruzzi & al., 2004), and 2*n* = 56 from Albania (Casper & Stimper, 2006).

*P. hirtiflora* var. *gionae* Contandr. & Quézel: 2*n* = 32 from Greece (Contandriopoulos & Quézel, 1974) and 2*n* = 56 from Albania (Casper & Stimper, 2006).

*P. hirtiflora* var. *megaspilaea* (Boiss. & Heldr.) Schindl.: 2*n* = 48 from Greece (Contandriopoulos & Quézel, 1974), and 2*n* = 56 from Albania (Casper & Stimper, 2006).

In fact, *Pinguicula* studies are difficult, owing to the numerous, small and agglutinated chromosomes that explain some erroneous counts. Nevertheless, in good metaphases of several individuals of this population, we always found 2*n* = 28 (L = 0.6–1.3 µm), which is in agreement with some previous reports of *P. hirtiflora* var. *hirtiflora* and var. *louisii*. On the other hand, the spread of this naturalized dynamic species threatens the survival of the endemic *P. reichenbachiana* in its locus classicus, owing to problems of competition and hybridization.

*Pinguicula reichenbachiana* Schindl.

2*n* = 32, CHN. France, Alpes-Maritimes, Fontan, Paganin Gorge, oozing cliff, 530 m, 21 Mar 2012, *Pires F12-18* (CBNMED); France, Alpes-Maritimes, Fontan, Chiapères Valley, wet cliff, 750 m, 22 Mar 2012, *Pires F12-15* (CBNMED); France, Alpes-Maritimes, Fontan, under Bergue, oozing cliff, 550 m, 22 Mar 2012, *Pires F12-17* (CBNMED); France, Alpes-Maritimes, Utelle, St-Honorat brook, oozing cliff, 530 m, 12 Jun 2012, *Pires S13-03* (CBNMED); Italy, Liguria, Castelvecchio di Rocca Barbena, N-W of the village, along the road, oozing cliff, 790 m, 10 May 2012, *Pires F12-16* (CBNMED); Italy, Liguria, Cisano sul Neva, Vale Ibà, wet cliff, 437 m, 11 May 2012, *Pires F12-14* (CBNMED) [Fig. 1B].

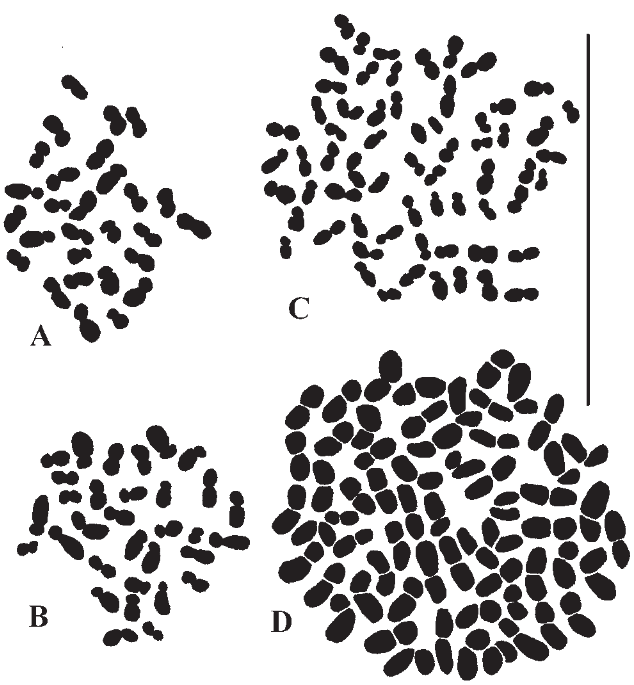


**Fig. 1.** Somatic metaphase. **A,** *Pinguicula hirtiflora*, 2*n* = 28; **B,** *Pinguicula reichenbachiana*, 2*n* = 32; **C,** *Pinguicula* cf. *vulgaris*, 2*n* = 64; **D,** *Teucrium pseudochamaepitys*, 2*n* = 60. — Scale bar = 10 µm

The only population in the Paganin Gorge (locus classicus) was counted by previous authors (Doulat, 1947; Casper & Stimper, 2009). We have extended the study to the main populations of this rare and protected endemic taxon of the Ligurian Alps. We found the same tetraploid chromosome number (2*n* = 32) in all localities. However, in its small geographical area, differentiation is still in progress, thus French populations possess homogeneous pollen, while Italian populations show heterogeneous pollen grains (size, coloring, anomalies) and floral anomalies.

*Pinguicula* cf. *vulgaris* L.

2*n* = 64, CHN. France, Alpes-Maritimes, Saorge, Gorges de Bendola, Castou Bridge, wet rock along the river, 430 m, 21 Mar 2012, *Pires F12-13* (CBNMED) [Fig. 1C].

For this widespread species, some earlier studies reported 2*n* = 50 (e.g., Tischler, 1934), whereas 2*n* = 64 was found by many authors from numerous countries: France (Doulat, 1947) to Lapland (e.g., Löve & Löve, 1944), Russia (Sokolovskaya, 1972) and U.S.A. (Wood & Godfrey, 1957).

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** New chromosome number for the species.

**VALERIANACEAE**

** *Nardostachys grandiflora* DC.

*n* = 39, 2*n* = 78, CHN. India, Tirthan Wildlife Sanctuary, Kullu, Himachal Pradesh, 31°41′55.75″N, 77°31′46.90″E, 2400–3000 m, 7 Jul 2012, *Kamini s.n.* (Herbarium, Dr. Y. S. Parmar University of Horticulture & Forestry, Himachal Pradesh, India, no. 8285).

The present chromosome count differs from the earlier report of 2*n* = 26 referred to by Goldblatt (1984). With *x* = 13, the cytotype studied here is presumably a hexaploid and regular meiosis indicates it to be genomic allopolyploid.

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* First chromosome count for the species.
** New chromosome number (cytotype) for the species.
▼ First chromosome count from an Indian accession.

The study is supported by financial grant under UGC-BSR Fellowship scheme (Award Letter no. 6007/04/04/2013) and IPLS-DBT (Reference number: BT/PR 4548/INF/22/146/2012).

**ASTERACEAE**

▼ *Aster himalaicus* C.B.Clarke

*n* = 9, CHN. India, Himachal Pradesh, Sirmaur, Churdhar, 30°52′N, 77°24′E, 3650 m, on grassy slopes, 15 Jul 2014, *V. Singh 31308* (PUN 59499) [Fig. 1A].

This report agrees with the previously published reports of 2*n* = 18 (Chouksanova & al., 1968; Garcia & al., 2009) from outside of India. From outside of India also 2*n* = 10 was reported (Tornadore & al., 2003).

▼ *Cremanthodium ellisii* (Hook.f.) Kitam.

*n* = 29, CHN. India, Himachal Pradesh, Sirmaur, Churdhar, 30°52′N, 77°24′E, 3650 m, on rocky slopes, 3 Sep 2012, *V. Singh 31348* (PUN 59647) [Fig. 1B].

This report agrees with the previously published reports of 2*n* = 58 (Liu & al., 2001) from outside of India.

** *Saussurea auriculata* (DC.) Sch.Bip.

*n* = 16, CHN. India, Himachal Pradesh, Sirmaur, Churdhar, 30°52′N, 77°24′E, 3650 m, on grasslands, 4 Sep 2012, *V. Singh 31358* (PUN 59656) [Fig. 1C].

* *Saussurea piptathera* Edgew.

*n* = 13, CHN. India, Himachal Pradesh, Sirmaur, Churdhar, 30°52′N, 77°24′E, 3650 m, on grassy slopes, 4 Sep 2012, *V. Singh 31354* (PUN 59652) [Fig. 1D].

* *Saussurea taraxacifolia* Wall. ex DC.

*n* = 16, CHN. India, Himachal Pradesh, Sirmaur, Churdhar, 30°52′N, 77°24′E, 3650 m, on grasslands, 16 Aug 2012, *V. Singh 31345* (PUN 59644) [Fig. 1E].

*Saussurea roylei* C.B.Clarke

*n* = 17, CHN. India, Himachal Pradesh, Sirmaur, Churdhar, 30°52′N, 77°24′E, 3650 m, on grassy slopes, 4 Sep 2012, *V. Singh 31350* (PUN 59665) [Fig. 1F].

This report agrees with the previous one (2*n* = 34) from India (Malik & Gupta, 2013).

*Synedrella vialis* (Less.) A.Gray

*n* = 12, CHN. India, Himachal Pradesh, Sirmaur, Shilai, 30°52′N, 77°24′E, 2700 m, along road side, 24 Sep 2013, *V. Singh 31338* (PUN 59637) [Fig. 1G].

This report agrees with the previously published one (2*n* = 24, Bala & Gupta, 2011).

* *Waldheimia glabra* (Decne.) Regel

*n* = 12, CHN. India, Himachal Pradesh, Sirmaur, Churdhar, 30°52′N, 77°24′E, 3650 m, on slopes, 15 Aug 2012, *V. Singh 31355* (PUN 59653) [Fig. 1H].

**BORAGINACEAE**

▼ *Cynoglossum glochidiatum* Wall. ex Benth.

*n* = 12, CHN. India, Himachal Pradesh, Sirmaur, Tisri, 30°49′N, 77°25′E, 3100 m, on slopes, 4 Sep 2012, *V. Singh 31371* (PUN 59657) [Fig. 1I].

This report agrees with the previous report of 2*n* = 24 (Khatoon & Ali, 1993) from outside of India.

*Hackelia uncinata* (Royle ex Benth.) C.E.C.Fisch.

*n* = 12, CHN. India, Himachal Pradesh, Sirmaur, Churdhar, 30°52′N, 77°24′E, 3650 m, on slopes, 4 Sep 2012, *V. Singh 31373* (PUN 59659) [Fig. 1J].

Previously, this diploid chromosome number (2*n* = 24) was reported from India (Mehra & Vasudevan, 1972; Vasudevan, 1975) as well as from outside of India (Britton, 1951).

**CAMPANULACEAE**

* *Campanula aristata* Wall.

*n* = 14, CHN. India, Himachal Pradesh, Sirmaur, Churdhar, 30°52′N, 77°24′E, 3650 m, on slopes, 4 Sep 2012, *V. Singh 30306* (PUN 58813) [Fig. 1K].

**GENTIANACEAE**

*Gentiana moorcroftiana* Wall. ex G.Don

*n* = 10, CHN. India, Himachal Pradesh, Sirmaur, Churdhar, 30°52′N, 77°24′E, 3360 m, on slopes, 8 Jul 2013, *V. Singh 30315* (PUN 59506) [Fig. 1L].

Previously, diploid chromosome number 2*n* = 18 (Vasudevan, 1975) was reported for this species from India.

*Gentiana carinata* Griseb.

*n* = 10, CHN. India, Himachal Pradesh, Sirmaur, Churdhar, 30°52′N, 77°24′E, 3650 m, on slopes, 8 Jul 2013, *V. Singh 30313* (PUN 59504) [Fig. 1M].

Previously, diploid chromosome number 2*n* = 20 (Jee & al., 1985; Jee & al., 1989) and tetraploid chromosome number 2*n* = 40 (Mehra & Gill, 1968) were reported for this species from India.

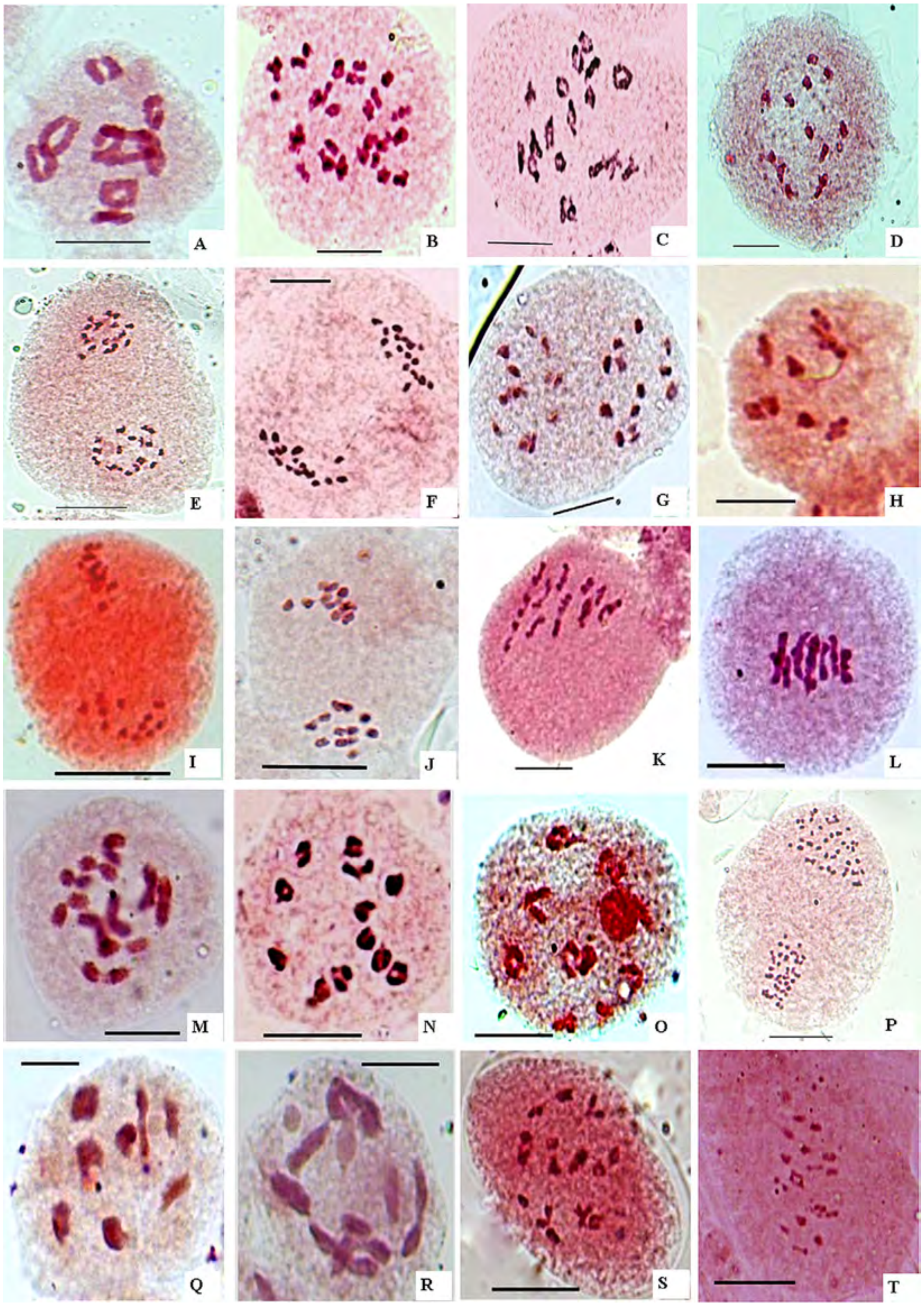


**Fig. 1. A,** *Aster himalaicus*, PMC at Diakinesis, $n = 9$ (PUP 59499); **B,** *Cremanthodium ellisii*, PMC at Metaphase, $n = 29$ (PUP 59647); **C,** *Saussurea auriculata*, PMC at Diakinesis, $n = 16$ (PUP 59656); **D,** *Saussurea piptathera*, PMC at Metaphase I, $n = 13$ (PUP 59652); **E,** *Saussurea taraxacifolia*, PMC at Anaphase I, $n = 16$ (PUP 59644); **F,** *Saussurea roylei*, PMC at Anaphase I, $n = 17$ (PUP 59665); **G,** *Synedrella vialis*, PMC at Anaphase I, $n = 12$ (PUP 59637); **H,** *Waldheimia glabra*, PMC at Metaphase I, $n = 12$ (PUP 59653); **I,** *Cynoglossum glochidiatum*, PMC at Anaphase I, $n = 12$ (PUP 59657); **J,** *Hackelia uncinata*, PMC at Anaphase I, $n = 12$ (PUP 59659); **K,** *Campanula aristata*, PMC at Metaphase I, $n = 14$ (PUP 58813); **L,** *Gentiana moorcroftiana*, PMC at Metaphase I, $n = 10$ (PUP 59506); **M,** *Gentiana carinata*, PMC at Metaphase I, $n = 10$ (PUP 59504); **N,** *Plantago himalaica*, PMC at Metaphase I, $n = 12$ (PUP 59512); **O,** *Primula elliptica*, PMC at Diakinesis, $n = 11$ (PUP 59660); **P,** *Euphrasia officinalis*, PMC at Anaphase I, $n = 44$ (PUP 59662); **Q,** *Pedicularis oederi*, PMC at Metapahse I, $n = 8$ (PUP 59502); **R,** *Pedicularis heterodonta*, PMC at Diakinesis, $n = 8$ (PUP 59664); **S,** *Scrophularia decomposita*, PMC at Metaphase I, $n = 15$ (PUP 59658); **T,** *Veronica himalensis*, PMC at Metaphase I, $n = 16$ (PUP 59503).

**PLANTAGINACEAE**

*Plantago himalaica* Pilg.

*n* = 12, CHN. India, Himachal Pradesh, Sirmaur, Tisri, 30°49′N, 77°25′E, 3100 m, along road sides, 9 Jul 2013, *V. Singh 31320* (PUN 59512) [Fig. 1N].

Previously, diploid chromosome number (*n* = 6, Jee & al., 1985, 1989) was reported for this species from India.

**PRIMULACEAE**

*Primula elliptica* Royle

*n* = 11, CHN. India, Himachal Pradesh, Sirmaur, Churdhar, 30°52′N, 77°24′E, 3650 m, on slopes, 16 Aug 2013, *V. Singh 31374* (PUN 59660) [Fig. 1O].

This report agrees with the previous reports of 2*n* = 22 from India (Sarkar, 1988) and outside of India (Kress, 1969).

**SCROPHULARIACEAE**

** *Euphrasia officinalis* L.

*n* = 44, CHN. India, Himachal Pradesh, Sirmaur, Churdhar, 30°52′N, 77°24′E, 3650 m, on grassy slopes, 26 Aug 2014, *V. Singh 31376* (PUN 59662) [Fig. 1P].

Previously, two cytotypes were reported, one with 2*n* = 22 from outside India (Tischler, 1950; Reese, 1952) and a second one with 2*n* = 44 from India (Vasudevan, 1975) as well as from outside of India (Reese, 1952).

▼ *Pedicularis oederi* Vahl

*n* = 8, CHN. India, Himachal Pradesh, Sirmaur, Churdhar, 30°52′N, 77°24′E, 3650 m, on rocky slopes, 7 Jul 2013, *V. Singh 30311* (PUN 59502) [Fig. 1Q].

Previously, 2*n* = 16 (Krogulevich, 1976, 1978; Murín & al., 1984) was reported from outside of India.

* *Pedicularis heterodonta* Pančić ex Janka

*n* = 8, CHN. India, Himachal Pradesh, Sirmaur, Churdhar, 30°52′N, 77°24′E, 3650 m, on grassy slopes, 4 Sep 2013, *V. Singh 31378* (PUN 59664) [Fig. 1R].

* *Scrophularia decomposita* Royle ex Benth.

*n* = 15, CHN. India, Himachal Pradesh, Sirmaur, Churdhar, 30°52′N, 77°24′E, 3650 m, on slopes, 4 Sep 2012, *V. Singh 31373* (PUN 59658) [Fig. 1S].

** *Veronica himalensis* D.Don

*n* = 16, CHN. India, Himachal Pradesh, Sirmaur, Churdhar, 30°52′N, 77°24′E, 3650 m, on slopes, 8 Jul 2013, *V. Singh 30312* (PUN 59503) [Fig. 1T].

Previously, 2*n* = 14 (Yamashita, 1937) and 2*n* = 16 (Hofelich, 1935) were reported for this species.

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