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IOPB COLUMN

Edited by Karol Marhold & Ilse Breitwieser

IAPT/IOPB chromosome data 21

Edited by Karol Marhold & Jaromír Kučera

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

ASTERACEAE

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

CALLITRICHACEAE

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

PLANTAGINACEAE

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

RANUNCULACEAE

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

Matthias Baltisberger & Babette Baltisberger

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All material CHN; collectors: BMB = Babette & Matthias Baltisberger, MB = Matthias Baltisberger; vouchers in Z+ZT.

AMARYLLIDACEAE

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

APIACEAE

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

ASTERACEAE

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

BRASSICACEAE

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

CARYOPHYLLACEAE

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

FABACEAE

Medicago falcata L., $2n = 32$; 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., $2n = 22$; Greece, BMB 17491.
Scutellaria rubicunda Willd., $2n = 34$; Greece, BMB 14930.
Stachys plumosa Griseb., $2n = 34$; Greece, BMB 14874, BMB 15054.

PLANTAGINACEAE

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

POACEAE

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

RANUNCULACEAE

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

ROSACEAE

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

SCROPHULARIACEAE

Scrophularia heterophylla Willd., $2n = 26$; 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., $2n = 54$; Espeut F12-102, F15-101, Verlaque R15-51.
Muscari olivetorum Blanca & al., $2n = 45$; Espeut F14-103, Verlaque R15-50.

VIOLACEAE

Viola biflora L., $2n = 12$; Espeut F14-2.
Viola bubanii Timb., $2n = 52$; Espeut F15-4.
Viola cornuta L., $2n = 22$; Espeut F14-3.
Viola lactea Sm., $2n =$ ca. 58; Espeut F07-6.
Viola lutea Huds., $2n = 48$; Espeut F14-4. $2n = 50$; Espeut F14-5.

Viola parvula Tineo, $2n = 10$; Espeut F05-54.
Viola riviniana Rehb., $2n = 40$; Espeut F14-1.
Viola tricolor subsp. *subalpina* (Latourr.) Gaudin, $2n = 26$; Espeut F05-53.

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All materials CHN; collected in India; collector: KK = Kuljit Kaur; vouchers in PUN.

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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

Melhantha 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, AS = Å. Svensson, CL = C.J. Löser, GJC = G.J. Cunnell, IH = I. Hodálová, JK = J. Kučera, MS = M. Slovák, PM

= P. Mered'a, PR = P. Repa, SG = S. Godefroid, TT = T. Tyler, UGA = U.-G. Andersson. Vouchers are deposited in SAV.

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COMPOSITAE

Picris hieracioides L. subsp. *hieracioides*

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

$2n \sim 2x \sim 10$, $2C = 2.10\text{--}2.93$ pg, FCM. Belgium, SG BE2_1, SG BE2_2, SG BE2_3; Bosnia and Herzegovina, JK & MS BOSL_1, JK & MS BOSL_2, JK & MS BOSL_3; Bulgaria, JK & MS BGL_1, JK & MS BGL_2, JK & MS BGL_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 CZL_2, JK & MS CZL_4, JK & MS CZL_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 DEL_2, JK & MS DEL_4, JK & MS DEL_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 LONI, 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 SUVL_1, JK & MS SUVL_2, JK & MS SUVL_3; Slovakia, MS & JK KOZ1, MS & JK KOZ2, MS & JK KOZ3; Sweden, AS, UGA & TT SKN1, AS, UGA & TT SKN2, AS, UGA & TT SKN3; Turkey, JK & MS TRB1, JK & MS TRB2, JK & MS TRB3, JK & MS IZM1, JK & MS IZM3; Ukraine, IH & PM CHRE1.

$2n \sim 3x \sim 15$, $2C = 3.83$ pg, FCM. Turkey, JK & MS IZM2.

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

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

$2n \sim 2x \sim 10$, $2C = 2.94\text{--}3.23$ 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.

$2n = 2x = 10$, CHN. Romania, MS, JK & PR RO11_1, MS, JK & PR RO13_1, MS, JK & PR RO27_1.

$2n \sim 2x \sim 10$, $2C = 2.90\text{--}3.17$ 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 UAL1.

$2n = 4x = 20$, CHN. Romania, MS, JK & PR RO31_1.

$2n \sim 4x \sim 20$, $2C = 6.06\text{--}6.20$ pg, FCM. Romania, MS, JK & PR RO31_1, MS, JK & PR RO31_2, MS, JK & PR RO31_3.

Picris hieracioides s.l.

$2n \sim 2x \sim 10$, $2C = 2.34\text{--}3.03$ pg, FCM. Germany, JK & MS DE4_2, JK & MS DE4_2a, JK & MS DE4_3, CL JEN1, CL JEN2, CL

JEN2a; Poland, JK & MS PLL_3, JK & MS PLL_3a, JK & MS PLL_5, JK & MS PL2_1, JK & MS PL2_2, JK & MS PL2_3; Sweden, AS, UGA & TT OLAI, AS, UGA & TT OLA2, AS, UGA & TT OLA3.

Picris olympica Boiss.

$2n = 2x = 10$, CHN. Turkey, JK & MS BOZI, JK & MS ULUI.

$2n \sim 2x \sim 10$, $2C = 2.72\text{--}3.32$ pg, FCM. Turkey, JK & MS BOZI, JK & MS BOZ2, JK & MS BOZ3, JK & MS ULUI, 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., $2n = 60$; France, Pires F14-05.

LENTIBULARIACEAE

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

Pinguicula reichenbachiana Schindl., $2n = 32$; France, Pires F12-15, Pires F12-17, Pires F12-18, Pires SI3-03; Italy, Pires F12-14, Pires SI2-16.

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

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All material CHN.

VALERIANACEAE

Nardostachys grandiflora DC., $n = 39$, $2n = 78$; 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.

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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.

IOPB COLUMN

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IAPT/IOPB chromosome data 21 [extended online version]

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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.

$2n = 22$, 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

$2n = 22$, 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].

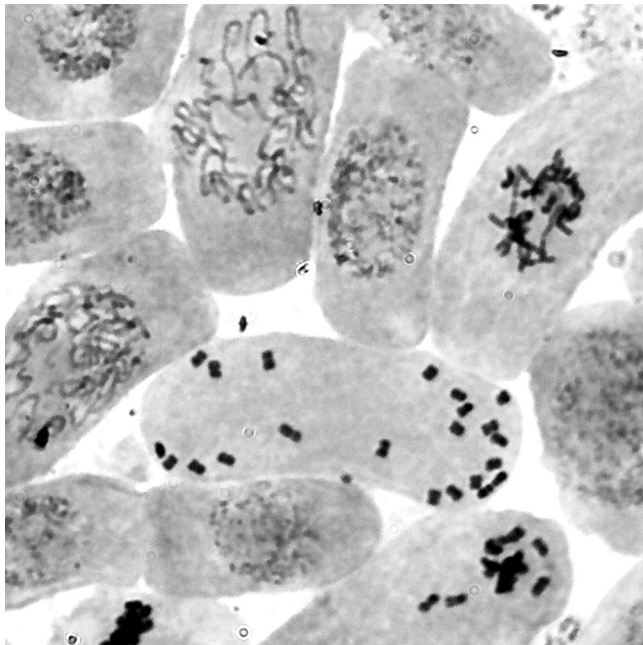


Fig. 1. *Magadania olaensis*, $2n = 22$ (*O. Mochalova M11001*, MAG).

ASTERACEAE

Erigeron silenifolius (Turcz.) Botsch.

$2n = 18$, 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.

$2n = 6$, 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.

$2n = 20$, 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

$2n = 12$, 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.

$2n = 32$, 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.

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

$2n = 24$, CHN. Russia, North of Far East, Magadanskaya Oblast', Olskii Raion, in vicinity of Ola settlement, Uglkanka 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, Uglkanka 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, Uglkanka 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).

$2n = 32$, 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, Uglkanka River, non-freezing

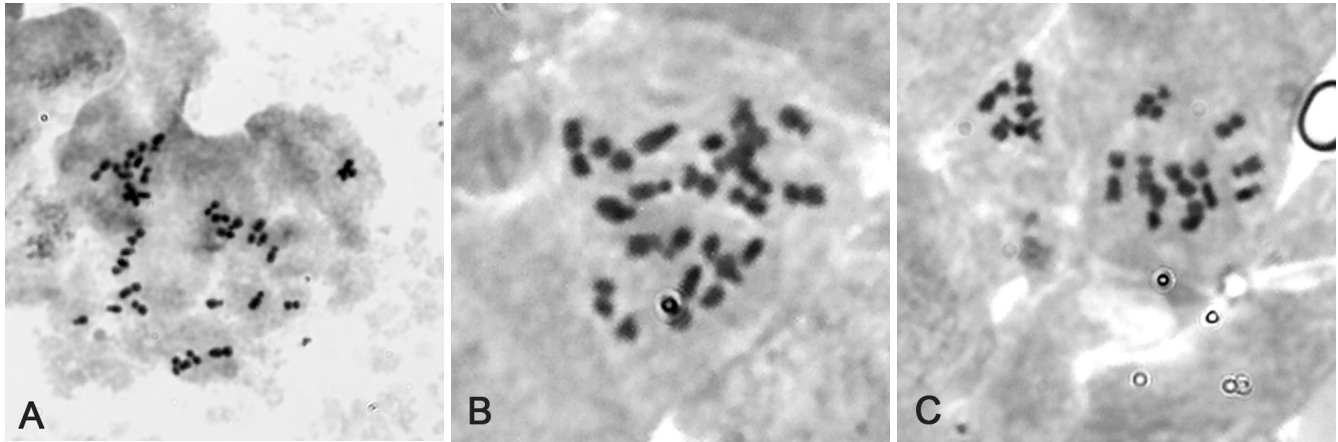


Fig. 2. **A**, *Ranunculus gmelinii*, $2n = 32$ (*E. Andriyanova* A14005c, MAG); **B**, *Ranunculus gmelinii*, $2n = 24$ (*E. Andriyanova* A14005b, MAG); **C**, *Ranunculus gmelinii*, $2n = 16$ (*E. Andriyanova* A14005a, MAG).

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

There by three different chromosome numbers were registered in Uglíkanka 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 $2n=24$.

Ranunculus lapponicus L.

$2n = 16$, 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

$2n = 32$, CHN. Russia, North of Far East, Magadanskaya Oblast', Olskii Raion, in vicinity of Ola settlement, Uglíkanka 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.

$2n = 32$, 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

$2n = 24$, 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

$2n = 16$, 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 issledovaniya 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.

$2n = 22$, 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.

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

Orlaya kochii Heywood

$2n = 16$, 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

$2n = 12$, 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 $2n = 12$ 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.

$2n = 28$, 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.

$2n = 18$, CHN. Greece, Thessalia, NW of Trikkala, between Kas-traki 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.

$2n = 54$, CHN. Greece, Central Macedonia, NNE of Thessaloniaiki, 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 $2n = 2x = 18$ while *C. bonariensis* seems to be hexaploid as most records indicate the chromosome number of $2n = 6x = 54$ (or $n = 3x = 27$). All investigated plants of both types showed $2n = 54$ chromosomes (Fig. 1B). The question remains open if either hexaploid *C. canadensis* exist or *C. bonariensis* shows an extremely high morphological variability.

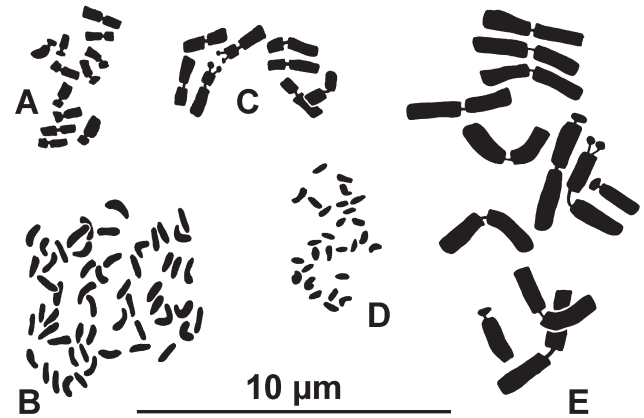


Fig. 1. Somatic metaphases. **A**, *Torilis arvensis* ($2n = 12$); **B**, *Conyza canadensis* s.l. ($2n = 54$); **C**, *Hypochaeris radicata* ($2n = 8$); **D**, *Thlaspi ochroleucum* ($2n = 28$); **E**, *Nigella damascena* ($2n = 12$).

Hypochaeris radicata L.

$2n = 8$, 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 $2n = 2x = 8$ 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.

$2n = 18$, 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.

$2n = 10$, 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

$2n = 32$, 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).

Staezelina petiolata (L.) Hilliard & B.L.Burt

$2n = 34$, 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 *Staezelina* 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 *Staezelina* are not uniform (e.g., $2n = 30, 34$) but all three Greek species show the same chromosome

number of $2n = 34$ (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 $2n = 34$ confirming earlier counts.

Garnatje & al. (2004) indicate $2n = 30$ for *S. uniflosculosa* the investigated plant material originating from the Botanical Garden Berlin-Dahlem. As all *Staeheleina*-taxa growing in Greece and Crete (see above) have $2n = 34$ 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.

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

Thlaspi ochroleucum Boiss. & Heldr.

$2n = 28$, CHN. Greece, Central Macedonia, WNW of Edessa, SE slope of Mt. Kajmakalan, 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 $2n = 2x = 14$ is known from two mountains in southern Greece (Mt. Timfristos and Mt. Vardousia, both Central Greece; Franzen & Gustavsson, 1983). The plants of Mt. Kajmakalan in northern Greece on the border to Macedonia proved to be tetraploid with $2n = 4x = 28$ chromosomes (Fig. 1D) which is a new ploidy level for this species.

CARYOPHYLLACEAE

Petrorhagia obcordata (Margot & Reut.) Greuter & Burdet

$2n = 30$, 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.

$2n = 32$, 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.

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

Scutellaria rubicunda Willd.

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

Stachys plumosa Griseb.

$2n = 34$, 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.

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

POACEAE

Aegilops neglecta Req. ex Bertol.

$2n = 42$, 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 $2n = 4x = 28$ as well as hexaploid plants with $2n = 6x = 42$ are known. The plants investigated here proved to be hexaploid.

RANUNCULACEAE

Nigella damascena L.

$2n = 12$, 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 $2n = 2x = 12$ 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.

$2n = 32$, 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* (Hauskn.) E.Mayer

$2n = 16$, 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 $2n = 2x = 16$ chromosomes as was confirmed by the plants investigated.

Ranunculus bulbosus L.

$2n = 16$, 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.

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

Ranunculus muricatus L.

$2n = 48$, 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.

$2n = 32$, CHN. Greece, Central Greece, between Amfissa and Nafaktos, 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.

$2n = 32$, 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.

$2n = 32$, 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.

$2n = 16$, 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.

$2n = 42$, CHN. Greece, Central Macedonia, WNW of Edessa, SE slope of Mt. Kajmakalan, 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.

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

Geum urbanum L.

$2n = 42$, 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.

$2n = 26$, 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).

Literature cited

- Baltisberger, M.** 1993. Zytologische Untersuchungen an Compositen aus Albanien. *Candollea* 48: 437–448.
- Baltisberger, M. & Baltisberger, E.** 1995. Karyological data of Albanian plants. *Candollea* 50: 457–493.
- Baltisberger, M. & Lippert, W.** 1987. Compositen aus Albanien. *Candollea* 42: 679–691.
- Baltisberger, M. & Widmer, A.** 2009. Karyological data of angiosperms from Romania. *Willdenowia* 39: 353–363. <http://dx.doi.org/10.3372/wi.39.39213>
- Barghi, N., Mugnier, C. & Siljak-Yakovlev, S.** 1989. Karyological studies in some *Hypochoeris* spp. (Compositae) from Sicily. *Pl. Syst. Evol.* 168: 49–57. <http://dx.doi.org/10.1007/BF00936106>

- Bhattacharyya, N.K.** 1958. Cytology of two species of *Nigella*. *Génet. Ibér.* 10: 179–191.
- Capineri, R., d'Amato, G. & Marchi, P.** 1978. Numeri cromosomici per la Flora Italiana: 534–583. *Inform. Bot. Ital.* 10: 421–465.
- Clapham, A.R. & Akeroyd, J.R.** 1993. *Thlaspi* L. Pp. 384–388 in: Tutin, T.G., Burges, N.A., Chater, A.O., Edmondson, J.R., Heywood, V.H., Moore, D.M., Valentine, D.H., Walters, S.M. & Webb, D.A. (eds.), *Flora Europaea*, ed. 2., vol. 1. Cambridge: Cambridge University Press.
- Cronquist, A.** 1976. *Conyza* Less. P. 120 in: Tutin, T.G., Heywood, V.H., Burges, N.A., Moore, D.M., Valentine, D.H., Walters, S.M. & Webb, D.A. (eds.), *Flora Europaea*, vol. 4. Cambridge: Cambridge University Press.
- Danin, A.** 1976a. On three adventive species of *Conyza* (Compositae) in Greece. *Candollea* 31: 107–109.
- Danin, A.** 1976b. Notes on four adventive Composites in Israel. *Notes Roy. Bot. Gard. Edinburgh* 34: 403–410.
- Datta, A.K. & Biswas, A.K.** 1983. Karyotype analysis in four *Nigella* species. *Cell Chromosome Res.* 6: 21–24.
- Datta, A.K. & Saha, A.** 2003. Cytomorphological studies and seed protein characterization of *Nigella sativa* L. and *Nigella damascena* L. *Cytologia* 68: 51–60. <http://dx.doi.org/10.1508/cytologia.68.51>
- De Montmollin, B.** 1986. Etude cytotaxonomique de la flore de Crète. III. Nombres chromosomiques. *Candollea* 41: 431–439.
- Dimitrova, D.** 1999. Mediterranean chromosome number reports 9 (1055–1057). *Fl. Medit.* 9: 343–346.
- Do Amaral Franco, J.** 1976. *Staezelina* L. P. 217 in: Tutin, T.G., Heywood, V.H., Burges, N.A., Moore, D.M., Valentine, D.H., Walters, S.M. & Webb, D.A. (eds.), *Flora Europaea*, vol. 4. Cambridge: Cambridge University Press.
- Franzen, R. & Gustavsson, A.** 1983. Chromosome numbers in flowering plants from the high mountains of Sterea Ellas, Greece. *Willdenowia* 13: 101–106.
- Garnatje, T., Vilatersana, R., Susanna, A., Valles, J. & Siljak-Yakovlev, S.** 2004. Contribution to the karyological knowledge of *Echinops* (Asteraceae, Cardueae) and related genera. *Bot. J. Linn. Soc.* 145: 337–344. <http://dx.doi.org/10.1111/j.1095-8339.2003.00280.x>
- Ghosh, A. & Datta, A.K.** 2006. Karyotyping of *Nigella sativa* L. (black cummin) and *Nigella damascena* L. (love-in-a-mist) by Imaging Analyzing System. *Cytologia* 71: 1–4. <http://dx.doi.org/10.1508/cytologia.71.1>
- Gilot-Delhalle, J.** 1970. Contribution à l'étude cytotaxonomique du genre *Nigella* L. *Caryologia* 23: 211–223.
- Goldblatt, P. & Johnson, D.E. (eds.)** 1979–. Index to plant chromosome numbers (IPCN). <http://mobot.mobot.org/W3T/Search/ipcn.html> (last access 22 Oct 2015).
- Greuter, W., Burdet, H.M. & Long, G. (eds.)** 1989. *Med-Checklist*, vol. 4, *Dicotyledones (Lauraceae – Rhamnaceae)*. Geneva: Editions Cons. Jard. Bot. Ville de Genève.
- Halacsy, E.** 1902. *Conspectus Florae Graecae*, vol. 2. Lipsiae [Leipzig]: sumptibus Guilelmi Engelmann. <http://dx.doi.org/10.5962/bhl.title.9919>
- Hamal, I.A. & Koul, A.K.** 1988. Cytotaxonomic analysis of the Himalayan species of the genus *Torilis* (Apiaceae). *Pl. Syst. Evol.* 159: 185–192. <http://dx.doi.org/10.1007/BF00935971>
- Hayek, A. & Markgraf, F.** 1931. *Prodromus Florae peninsulae Balcanicae*, vol. 2, *Dicotyledoneae Sympetalae*. Dahlem bei Berlin: Verlag des Repertoriums.
- Hess, H.E., Landolt, E., Hirzel, R. & Baltisberger, M.** 2015. *Bestimmungsschlüssel zur Flora der Schweiz und angrenzender Gebiete*, ed. 7. Basel: Springer.
- IPNI** 2015. The International Plant Names Index. <http://www.ipni.org> (accessed 20 Oct 2015).
- Levan, A., Fredga, K. & Sandberg, A.A.** 1964. Nomenclature for centromeric position on chromosomes. *Hereditas (Lund)* 52: 201–220. <http://dx.doi.org/10.1111/j.1601-5223.1964.tb01953.x>
- Mitra, P.K. & Bhowmik, G.** 1996. Cytomorphological studies in some species of *Nigella*. *J. Cytol. Genet.* 31: 199–204.
- Mugnier, C. & Siljak-Yakovlev, S.** 1987. Karyological study in some Yugoslavian populations of *Hypochoeris* (Compositae). *Caryologia* 40: 319–325. <http://dx.doi.org/10.1080/00087114.1987.10797834>

- Oberprieler, C. & Vogt, R.** 2002. *Hypochaeris arachnoidea* Poir., a hitherto neglected species in NW Africa. *Willdenowia* 32: 231–236. <http://dx.doi.org/10.3372/wi.32.32205>
- Phitos, D. & Kamari, G.** 1984. Cytotaxonomical contributions on the Flora of Crete. II. *Candollea* 39: 447–451.
- Rechinger, K.H.** 1943a. Flora Aegaea: Flora der Inseln und Halbinseln des ägäischen Meeres. *Denkschr. Akad. Wiss. Wien, Math.-Naturwiss. Kl.* 105(1): 1–924.
- Rechinger, K.H.** 1943b. Flora Aegaea: Flora der Inseln und Halbinseln des ägäischen Meeres. *Denkschr. Akad. Wiss. Wien, Math.-Naturwiss. Kl.* 105(2): 1–184.
- Ruas, C.F., Ruas, P.M., Matzenbacher, N.L., Ross, G., Bernini, C. & Vanzela, A.L.L.** 1995. Cytogenetic studies of some *Hypochaeris* species (Compositae) from Brazil. *Amer. J. Bot.* 82: 369–375. <http://dx.doi.org/10.2307/2445582>
- Serra, C., Valdes, B., Marcucci, R. & Tornadore, N.** 2001. Mediterranean chromosome number reports II (1254–1263). *Fl. Medit.* 11: 466–473.
- Siljak-Yakovlev, S.** 1996. La dyspléidie et l'évolution du caryotype. *Bocconea* 5: 211–220.
- Yannitsaros, A. & Economidou, E.** 1974. Studies on the adventive flora of Greece. I. General remarks on some recently introduced taxa. *Candollea* 29: 111–119.

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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.

$2n = 54$, 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.

$2n = 45$, 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.Küpf. 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 exerted 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* (2x) and *M. baeticum* (6x), 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* (5x) differs from *M. neglectum* (4x) with regard to much higher number of bulbils (20–50 vs. 10–30) and longer inflorescences. In these taxa, vegetative multiplication and

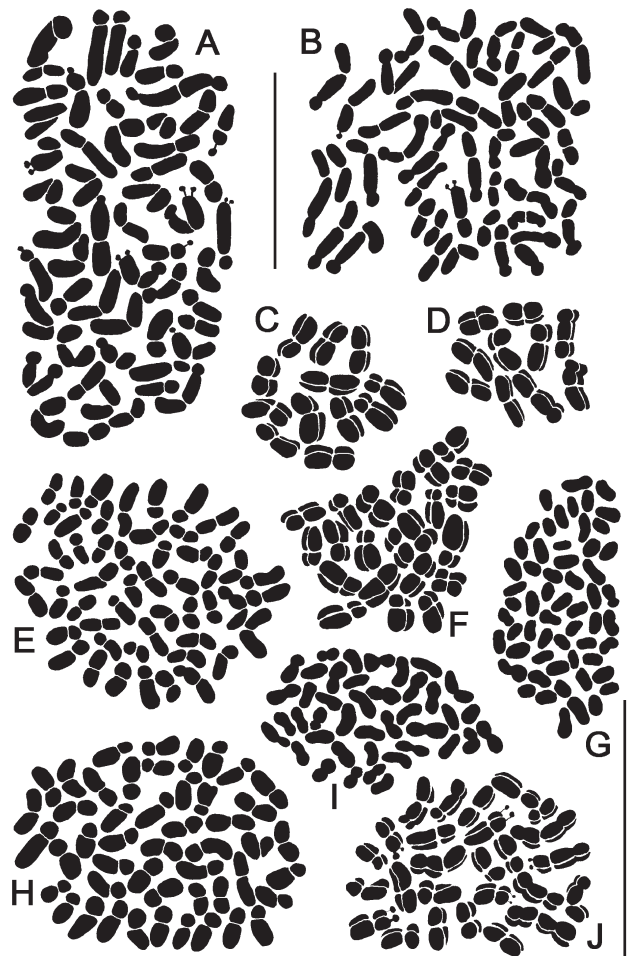


Fig. 1. Somatic metaphase. **A & B**, In root tips (first scale); **A**, *Muscari baeticum*, $2n = 54$; **B**, *M. olivetorum*, $2n = 45$; **C–J**, In ovary (second scale); **C**, *Viola biflora*, $2n = 12$; **D**, *V. parvula*, $2n = 10$; **E**, *V. bubanii*, $2n = 52$; **F**, *V. cornuta*, $2n = 22$;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

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

VIOLACEAE

▼ *Viola biflora* L.

$2n = 12$, 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.

$2n = 52$, 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*": $2n = 42–44$ 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* ($2n = 52$, 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.

$2n = 22$, CHN. France, Pyrénées-Orientales, commune of Puyvalador, between Fontrabieuse 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.

$2n = c. 58$, 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.

$2n = 50$, 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).

$2n = 48$, 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

$2n = 10$, 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* Rehb.

$2n = 40$, 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

$2n = 26$, 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].

Literature cited

- Aldasoro, J.J. & Lainz, M. 1992. Sobre la variabilidad morfológica ibérica de *Viola bubanii* Timb. *Anales Jard. Bot. Madrid* 50: 268.
- Krahulcová, A., Krahulec, F. & Kirschner, J. 1996. Introgressive hybridization between a native and an introduced species: *Viola lutea* subsp. *sudetica* versus *V. tricolor*. *Folia Geobot. Phytotax.* 31: 219–244. <http://dx.doi.org/10.1007/BF02812066>
- Ruiz-Rejon, M. & Oliver J.L. 1978. Numeros cromosomicos para la flora Española n°68–69. *Lagascalia* 8: 113–117.
- Suarez-Santiago, V.N., Salinas, M., Romero-García, A., Garrido-Ramos, M., De La Herrá, C., Ruiz-Rejon, M. & Blanca, G. 2007. Polyploidy, the major speciation mechanism in *Muscari* subgenus *Botryanthus* in the Iberian Peninsula. *Taxon* 56: 1171–1184. <http://dx.doi.org/10.2307/25065910>
- Suarez-Santiago, V.N. & Blanca, G. 2013. Genus *Muscari*. Pp. 171–184 in: Rico, E., Crespo, M.B., Quintanar, A., Herrero, A. & Aedo, C. (eds.), *Flora iberica*, vol. 20. Madrid: Real Jardín Botánico, CSIC.
- Verlaque, R. & Espeut, M. 2007. [Report] in: Marhold K. (ed.), IAPT/IOPB chromosome data 3. *Taxon* 56: 209. <http://www.ingentaconnect.com/contentone/iapt/tax/2007/00000056/00000001/art00023>

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* First chromosome count for the species.

** New chromosome report (cytotype) for the species.

▼ First chromosome count for an Indian accession.

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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 $2n = 24$ 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 $n = 11$ (Khatoun & 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 ($2n = 16$) from outside of India (Khatoun & 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 $2n = 22$ was reported for this species from India (Singh & Yadava, 1978).

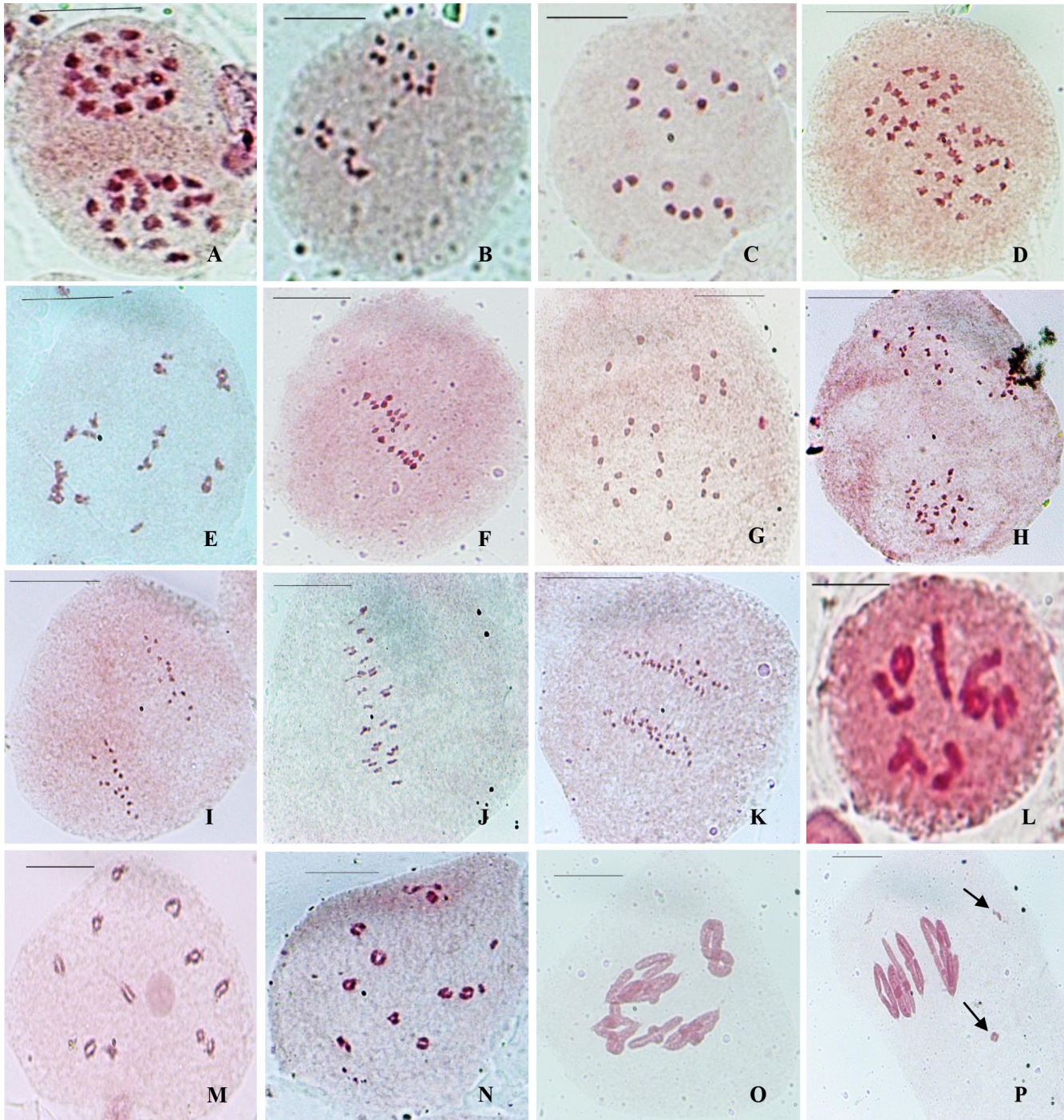


Fig. 1. **A**, *Farsetia hamiltonii*, PMC at Anaphase I, $n = 18$ (PUN 59676); **B**, *Dipterygium glaucum*, PMC at Anaphase I, $n = 11$ (PUN 59681); **C**, *Taverniera cuneifolia*, PMC at Anaphase I, $n = 8$ (PUN 59677); **D**, *Tephrosia wallichii*, PMC at Metaphase II, $n = 22$ (PUN 59678); **E**, *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 $2n = 72$ 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 $2n = 14$ (Xu & al., 1992) from outside of India, $2n = 28$ (Roy & al., 1988) and $2n = 22, 30$ (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 $2n = 28$ was reported for this species from India (Trivedi & Trivedi, 1992) and outside of India (Safonova, 1991). Besides this, chromosome number $2n = 112$ was also reported (Diers, 1961).

STERCULIACEAE

* *Melhanian 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 $2n = 32$ was reported for this species from outside of India (Paiva & Leitao, 1987) and hexaploid chromosome number $2n = 48$ 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 $2n = 18, 20, 22$ (Baquar, 1967) was reported for this species from outside of India and $2n = 20$ 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 $2n = 22$ (Baquar, 1967) and $2n = 20, 22$ (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 $2n = 22$ and 24 (Ma & al., 1984, 1990) from outside of India and $2n = 24$ from India (Singh, 1984) were reported for this species.

Literature cited

- Baquar, S.R.** 1967. Intraindividual numerical chromosome instability in *Fagonia cretica* L. *Genét. Ibér.* 19: 99–102.
- Bhansali, A.K. & Bhandari, M.M.** 1974. Chromosome number of Indian desert plants-I. *Geobios* 1: 144–145.
- Chatterjee, A. & Sharma, A.K.** 1970. Chromosome study in Geraniales. *Nucleus (Calcutta)* 13: 179–200.
- Cheng, Y.F. & Tsai, J.I.** 1999. Chromosome study of the Malvaceae in Taiwan. *Quart. J. Forest Res.* 21: 61–72.
- Diers, L.** 1961. Der Anteil und Polyploidien in den Vegetationsgürteln der Westkordillere Perus. *Z. Bot.* 49: 437–488.
- Jahan, B., Vahidy, A.A. & Ali, S.I.** 1994. Chromosome numbers in some taxa of Fabaceae mostly native to Pakistan. *Ann. Missouri Bot. Gard.* 81: 792–799. <http://dx.doi.org/10.2307/2399924>
- Khatoon, S. & Ali, S.I.** 1991. Chromosome numbers in subfamily Papilionoideae (Leguminosae) from Pakistan. *Willdenowia* 20: 159–165.
- Khatoon, S. & Ali, S.I.** 1993. *Chromosome atlas of the angiosperms of Pakistan*. Karachi: Department of Botany, University of Karachi.
- Krishnappa, D.G. & Munirajappa.** 1980. [Report] in: Löve, A. (ed.), Chromosome number reports LXXVIII. *Taxon* 29: 535–536. <http://www.jstor.org/stable/1220653>
- Krishnappa, D.G. & Munirajappa.** 1982. [Report] in: Löve, A. (ed.), IOPB chromosome number reports LXXVI. *Taxon* 31: 582–583. <http://www.jstor.org/stable/1220702>
- Ma, X.H., Qin, R.L. & Xing, W.B.** 1984. Chromosome observations of some medicinal plants in Xinjiang. *Acta Phytotax. Sin.* 22: 243–249.
- Ma, X.H., Ma, X.Q. & Li, N.** 1990. Chromosome observations of some drug plants in Xinjiang. *Acta Bot. Boreal.-Occid. Sin.* 10: 203–210.
- Munirajappa & Krishnappa, D.G.** 1989. Polyploidy in south Indian species of *Hibiscus*. *Vistas Cytogenet.* 1: 229–236.
- Paiva, J. & Leitao, M.T.** 1987. Numeros cromosomáticos de plantas de Africa tropical. *Fontqueria* 14: 37–44.
- Roy, S.C., Ghost, S. & Chatterjee, A.** 1988. A cytological survey of Eastern Himalayan plants II. *Cell. Chromosome Res.* 11: 93–97.
- Safonova, I.N.** 1991. Chromosome numbers in some species of the family Papaveraceae. *Bot. Zhurn. (Moscow & Leningrad)* 76: 904–905.
- Sharma, A.K. & Dhakre, J.S.** 1981. [Report] in: Löve, A. (ed.), Chromosome number reports LXXIII. *Taxon* 30: 854. <http://www.jstor.org/stable/1220093>
- Singh, A.K. & Yadava, K.S.** 1978. Cytological studies in *Tephrosia* and *Indigofera* species. *Geobios (Jodhpur)* 5: 124–125.
- Singh, P.** 1984. [Report] in: Löve, A. (ed.), IOPB Chromosome number reports, LXXXV. *Taxon* 33: 759. <http://www.jstor.org/stable/1220810>
- Trivedi, M.P. & Trivedi, R.N.** 1992. Chromosomal behaviour in weeds. Pp. 188–198 in: Chenna Veeraiah, M.S. (ed.), *Glimpses of cytogenetics in India*, vol. 3. Bangalore: Society of Cytologist and Genetics India.
- Xu, B.S., Weng, R.F. & Zhang, M.Z.** 1992. Chromosome numbers of Shanghai plants I. *Invest. Stud. Nat.* 12: 48–65.
- Zaidi, S.** 2003. Effects of electromagnetic fields (created by high tension lines) on the indigenous floral biodiversity in the vicinity of Karachi - I: Studies on PMC meiosis, meiotic products and pollen fertility. *Pakistan J. Bot.* 35: 743–755.

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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 *Solanum 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*,

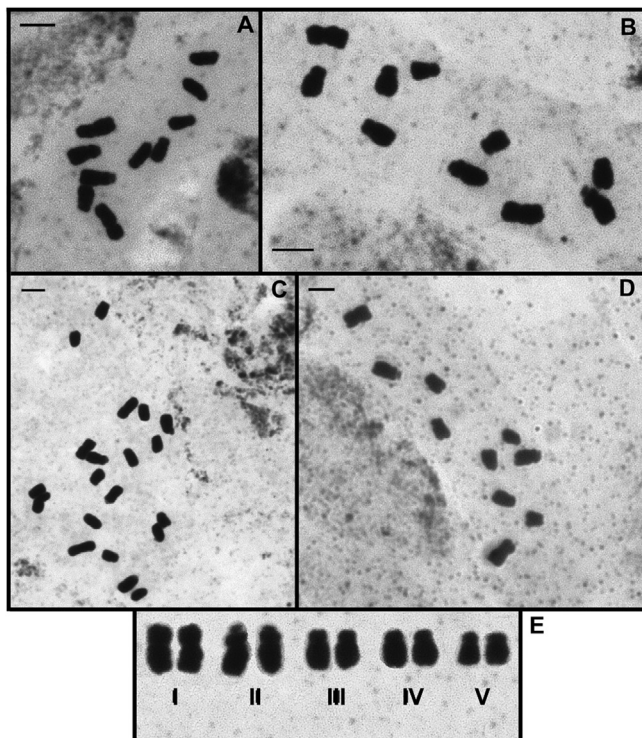


Fig. 1. Microphotographs of mitotic metaphases of *Picris hieracioides* subspecies and of *P. olympica*. **A**, *P. hieracioides* subsp. *hispidissima* (pop. KAR): $2n = 2x = 10$; **B**, *P. hieracioides* subsp. *umbellata* (pop. RO_11): $2n = 2x = 10$; **C**, *P. hieracioides* subsp. *umbellata* (pop. 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 $2m+2\text{sm}+4\text{sm}+2\text{st}$. For population codes, refer to the text. — Scale bars: 4 μm .

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 CHR B 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: CHR B 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).

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% acetic acid 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 G₁ 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%.

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

2n ~ 2x ~ 10, 2C = 2.11–2.16 pg, FCM. Belgium, Vlaams-Brabant, Wommel, 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).

2n ~ 2x ~ 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 BOSL_1, M. Slovák & J. Kučera BOSL_2, M. Slovák & J. Kučera BOSL_3* (SAV).

2n ~ 2x ~ 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 BGL_1, M. Slovák & J. Kučera BGL_2, M. Slovák & J. Kučera BGL_4* (SAV).

2n ~ 2x ~ 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).

2n ~ 2x ~ 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).

2n ~ 2x ~ 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).

2n ~ 2x ~ 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 CZL_2, M. Slovák & J. Kučera CZL_4, M. Slovák & J. Kučera CZL_5* (SAV).

2n ~ 2x ~ 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).

2n ~ 2x ~ 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).

2n ~ 2x ~ 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).

2n ~ 2x ~ 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 DEL_2, M. Slovák & J. Kučera DEL_4, M. Slovák & J. Kučera DEL_5* (SAV).

2n ~ 2x ~ 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).

2n ~ 2x ~ 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*

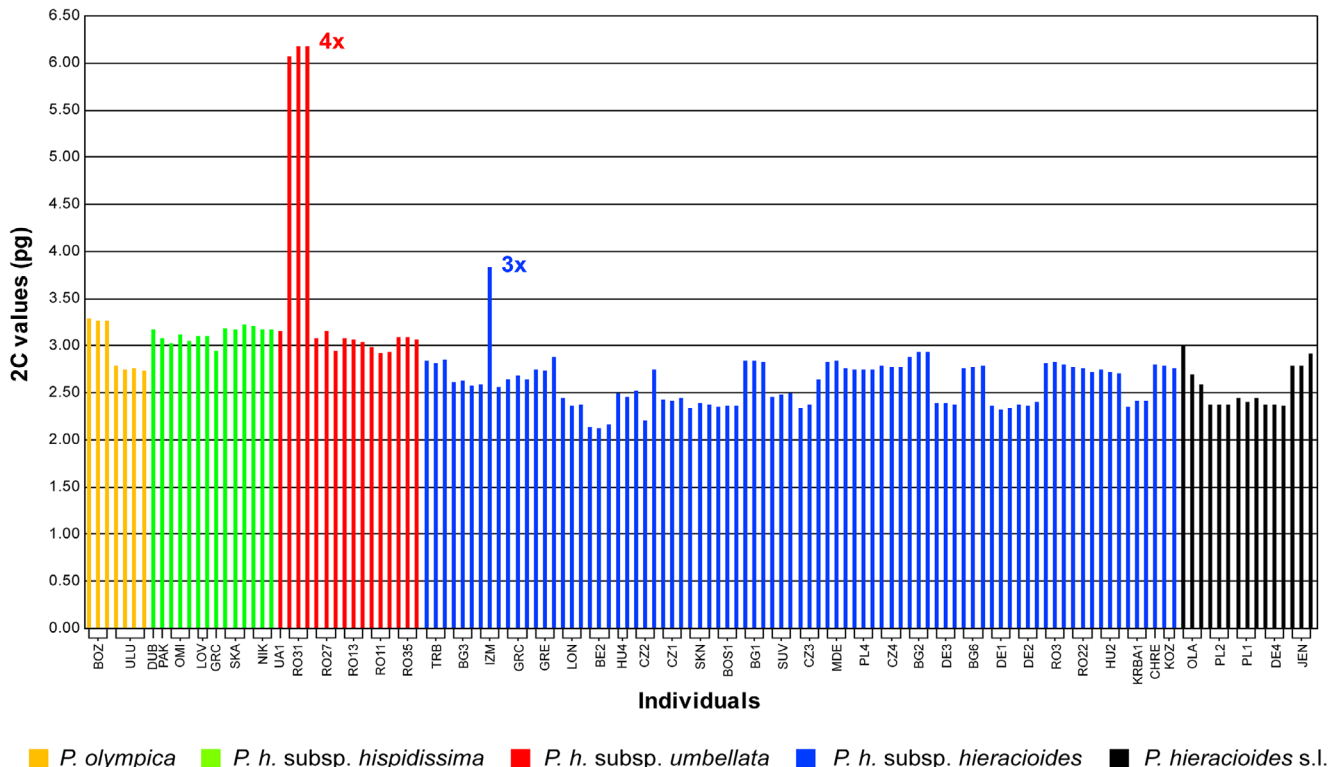


Fig. 2. Graph displaying genome size variation of analysed *Picris* taxa.

& *J. Kučera DE3_1*, *M. Slovák & J. Kučera DE3_la*, *M. Slovák & J. Kučera DE3_3* (SAV).

$2n \sim 2x \sim 10$, $2C = 2.32\text{--}2.43$ 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 KRBAL_1*, *M. Slovák & J. Kučera KRBAL_2*, *M. Slovák & J. Kučera KRBAL_3* (SAV).

$2n \sim 2x \sim 10$, $2C = 2.35\text{--}2.44$ pg, FCM. Great Britain, England, Greater London, 51°30'19"N, 00°07'26"W, 75 m, 22 Oct 1985, *G.J. Cunnell LON1*, *G.J. Cunnell LON2*, *G.J. Cunnell LON3* (SAV).

$2n \sim 2x \sim 10$, $2C = 2.60\text{--}2.69$ pg, FCM. Greece, Macedonia Thraki, Chamokerassa, 41°11'47"N, 24°23'48"E, 303 m, 19 Jun 2011, *M. Slovák, J. Kučera & A. Guttová GRCL*, *M. Slovák, J. Kučera & A. Guttová GRC2*, *M. Slovák, J. Kučera & A. Guttová GRC3* (SAV).

$2n \sim 2x \sim 10$, $2C = 2.73\text{--}2.78$ pg, FCM. Greece, Macedonia 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).

$2n \sim 2x \sim 10$, $2C = 2.70\text{--}2.75$ 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).

$2n \sim 2x \sim 10$, $2C = 2.42\text{--}2.49$ 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).

$2n \sim 2x \sim 10$, $2C = 2.74\text{--}2.85$ 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).

$2n \sim 2x \sim 10$, $2C = 2.73\text{--}2.75$ 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).

$2n \sim 2x \sim 10$, $2C = 2.79\text{--}2.82$ 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).

$2n \sim 2x \sim 10$, $2C = 2.72\text{--}2.78$ 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).

$2n \sim 2x \sim 10$, $2C = 2.44\text{--}2.52$ pg, FCM. Republic of Serbia, Šumadijaj zapadna Srbija, Suvobor, 44°07'28"N, 20°15'56"E, 694 m, 19 Jul 2009, *M. Slovák & J. Kučera SUVL_1*, *M. Slovák & J. Kučera SUVL_2*, *M. Slovák & J. Kučera SUVL_3* (SAV).

$2n \sim 2x \sim 10$, $2C = 2.75\text{--}2.79$ pg, FCM. Slovakia, Štiavnické vrchy Mts., village of Kozelnik, 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).

$2n \sim 2x \sim 10$, $2C = 2.33\text{--}2.40$ 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).

$2n \sim 2x \sim 10$, $2C = 2.54\text{--}2.58$ 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).

$2n \sim 2x \sim 10$, $2C = 2.79\text{--}2.88$ 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).

$2n \sim 2x \sim 10$, $2C = 2.79$ pg FCM. Ukraine, Khmel'nyts'ka oblast', Chrebtayev, 48°37'33"N, 27°14'25"E, 260 m, 20 Jul 2007, *I. Hodálová & P. Meredá CHRE1* (SAV).

$2n \sim 3x \sim 15$, $2C = 3.83$ 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%.

$2n = 2x = 10$, 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).

$2n \sim 2x \sim 10$, $2C = 3.16$ 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).

$2n \sim 2x \sim 10$, $2C = 2.95$ 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).

$2n \sim 2x \sim 10$, $2C = 3.08$ 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).

$2n \sim 2x \sim 10$, $2C = 2.99\text{--}3.15$ 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).

$2n \sim 2x \sim 10$, $2C = 3.07\text{--}3.13$ 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).

$2n \sim 2x \sim 10$, $2C = 3.12\text{--}3.23$ 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).

$2n \sim 2x \sim 10$, $2C = 3.13\text{--}3.23$ 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.

$2n = 2x = 10$, 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).

$2n = 2x = 10$, CHN. Romania, Braşov, Măgura, 45°31'51"N, 25°17'27"E, 977 m, 6 Aug 2010, *M. Slovák, J. Kučera & P. Repa RO13_1* (SAV).

$2n = 2x = 10$, 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).

$2n \sim 2x \sim 10$, $2C = 2.90\text{--}3.00$ 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).

$2n \sim 2x \sim 10$, $2C = 3.03\text{--}3.09$ pg, FCM. Romania, Braşov, 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).

$2n \sim 2x \sim 10$, $2C = 2.92\text{--}3.17$ 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).

$2n \sim 2x \sim 10$, $2C = 3.05\text{--}3.10$ 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).

$2n \sim 2x \sim 10$, $2C = 3.16$ pg FCM. Ukraine, Lvivská oblast, Lishnya, 49°25'17"N, 23°26'04"E, 313 m, 17 Aug 2011, *M. Slovák & J. Kučera UAL_1* (SAV).

$2n = 4x = 20$, CHN. Romania, Suceava, Sunători, 47°23'05"N, 25°28'38"E, 784 m, 10 Aug 2010, *M. Slovák, J. Kučera & P. Repa RO3L_1* (SAV).

$2n \sim 4x \sim 20$, $2C = 6.06\text{--}6.20$ pg, FCM. Romania, Suceava, Sunători, 47°23'05"N, 25°28'38"E, 784 m, 10 Aug 2010, *M. Slovák, J. Kučera & P. Repa RO3L_1*, *M. Slovák, J. Kučera & P. Repa RO3L_2*, *M. Slovák, J. Kučera & P. Repa RO3L_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%.

$2n \sim 2x \sim 10$, $2C = 2.34\text{--}2.39$ 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).

$2n \sim 2x \sim 10$, $2C = 2.76\text{--}2.93$ 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).

$2n \sim 2x \sim 10$, $2C = 2.39\text{--}2.47$ pg, FCM. Poland, Województwo zachodnio pomorskie, Płocin, 53°51'42"N, 14°33'26"E, 21 m, 23 Sep 2011, *M. Slovák & J. Kučera PLL_3*, *M. Slovák & J. Kučera PLL_3a*, *M. Slovák & J. Kučera PLL_5* (SAV).

$2n \sim 2x \sim 10$, $2C = 2.35\text{--}2.40$ 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).

$2n \sim 2x \sim 10$, $2C = 2.56\text{--}3.03$ 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%.

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

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

$2n \sim 2x \sim 10$, $2C = 3.24\text{--}3.32$ pg, FCM. Turkey, Izmir, Boz Dağları 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).

$2n \sim 2x \sim 10$, 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).

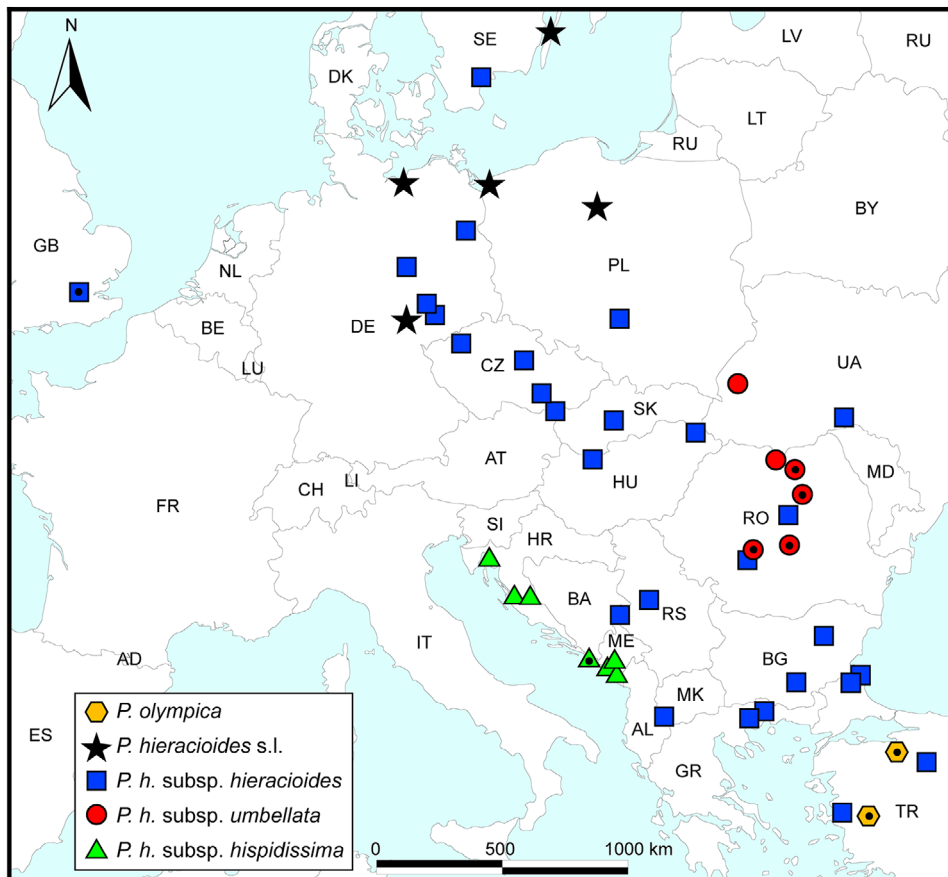


Fig. 3. Map displaying the geographic distribution of populations analysed karyologically within the present study. Symbols with a black dot in the centre indicate populations in which direct chromosome counting was performed.

Table 1. Karyotype characteristics of taxa under study.

Taxon	Chromosome pair (AR/RL)				
	I	II	III	IV	V
<i>P. hieracioides</i> s.l.	1.45/0.123	2.20/0.118	2.69/0.094	3.13/0.090	2.45/0.074
<i>P. hispidissima</i>	1.45/0.124	2.04/0.113	3.04/0.091	2.14/0.088	2.56/0.080
<i>P. olympica</i>	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).

Intraspecific 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 $2m+2\text{smsat}+4\text{sm}+2\text{st}$ (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
<i>P. h. hieracioides</i> LON1	2.43	22.66
<i>P. h. hispidissima</i> DUB8	3.16	30.48
<i>P. h. umbellata</i> RO11_1	2.98	24.25
<i>P. h. umbellata</i> RO13_1	3.07	23.49
<i>P. h. umbellata</i> RO27_1	3.08	22.70
<i>P. olympica</i> ULU1	2.78	24.54
<i>P. olympica</i> 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.

Literature cited

- Doležel, J., Doleželová, M. & Novák, F.J.** 1994. Flow cytometric estimation of nuclear DNA amount in diploid bananas (*Musa acuminata* and *M. balbisiana*). *Biol. Pl.* 36: 351–357. <http://dx.doi.org/10.1007/BF02920930>
- Galland, N.** 1988. Recherche sur l'origine de la flore orophile du Maroc: Étude caryologique et cytogeographique. *Trav. Inst. Sci. Univ. Mohammed V, Sér. Bot.* 35: 1–168.
- Greilhuber, J., Doležel, J., Lysák, M. & Bennett, M.D.** 2005. The origin, evolution and proposed stabilization of the terms 'genome size' and 'C-value' to describe nuclear DNA contents. *Ann. Bot. (Oxford)* 95: 255–260. <http://dx.doi.org/10.1093/aob/mci019>
- Humphries, C.J., Murray, B.G., Bocquet, G. & Vasudevan, K.** 1978. Chromosome numbers of phanerogams from Morocco and Algeria. *Bot. Not.* 131: 391–404.
- Levan, A., Fredga, K. & Sandberg, A.A.** 1965. Nomenclature for centromeric position on chromosomes. *Hereditas (Lund)* 52: 201–220. <http://dx.doi.org/10.1111/j.1601-5223.1964.tb01953.x>
- Mártonfióvá, L.** 2013. A method of standardization of chromosome length measurement. *Caryologia* 66: 304–312. <http://dx.doi.org/10.1080/00087114.2013.854565>
- Murín, A.** 1960. Substitution of cellophane for glass covers to facilitate preparation of permanent squashes and smears. *Stain Technol.* 35: 351–353.
- Oberprieler, C. & Vogt, R.** 1993. Chromosome numbers of north African phanerogams 2. *Willdenowia* 23: 211–238.
- Slovák, M., Šingliarová, B. & Mráz, P.** 2007. Chromosome numbers and mode of reproduction in *Picris hieracioides* s.l. (Compositae) with notes on some other *Picris* taxa. *Nordic J. Bot.* 28: 238–244. <http://dx.doi.org/10.1111/j.0107-055X.2007.00112.x>
- Slovák, M., Vít, P., Urfus, T. & Suda, J.** 2009a. Complex pattern of genome size variation in a polymorphic member of the Asteraceae. *J. Biogeogr.* 36: 372–384. <http://dx.doi.org/10.1111/j.1365-2699.2008.02005.x>
- Slovák, M., Urfus, T., Vít, T. & Marhold, K.** 2009b. Balkan endemic *Picris hispidissima* (Compositae): Morphology, DNA content and relationship to polymorphic *P. hieracioides*. *Pl. Syst. Evol.* 278: 187–201. <http://dx.doi.org/10.1007/s00606-008-0137-5>
- Slovák, M., Kučera, J., Marhold, K. & Zozomová-Lihová, J.** 2012. The morphological and genetic variation in the polymorphic species *Picris hieracioides* (Compositae, Lactuceae) in Europe strongly contrasts with traditional taxonomical concepts. *Syst. Bot.* 21: 258–278. <http://dx.doi.org/10.1600/036364412X616828>
- Slovák, M., Kučera, J., Závěská, E. & Vďačný, P.** 2014. Dealing with discordant genetic signal caused by hybridisation, incomplete lineage sorting and paucity of primary nucleotide homologies: A case study of closely related members of the genus *Picris* subsection *Hieracioides* (Compositae). *PLOS One* 9(9): e104929. <http://dx.doi.org/10.1371/journal.pone.0104929>
- Stepanov, N.V.** 1994. Chromosome numbers of some higher plant taxa of the flora of Krasnoyarsk region. *Bot. Zhurn. (Moscow & Leningrad)* 79: 135–139.
- Suda, J., Krahulcová, A., Trávníček, P. & Krahulec, F.** 2006. Ploidy level versus DNA ploidy level: An appeal for consistent terminology. *Taxon* 55: 447–450. <http://dx.doi.org/10.2307/25065591>
- Zhang, Y.** 1994. Studies on chromosomes of some plants from Guandi Mountain, Shanxi. *J. Wuhan Bot. Res.* 12: 201–206.
- Zhang, D.** 1998. The report on karyotypes of *Picris hieracioides* L. ssp. *japonica*. *J. Yantai Univ. (Nat. Sci. Engin.)* 12: 232–234.

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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 $2n = 56$ from Albania (Casper & Stimper, 2006).

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

P. hirtiflora var. *megaspilaea* (Boiss. & Heldr.) Schindl.: $2n = 48$ from Greece (Contandriopoulos & Quézel, 1974), and $2n = 56$ 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 $2n = 28$ ($L = 0.6\text{--}1.3\ \mu\text{m}$), 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.

$2n = 32$, CHN. France, Alpes-Maritimes, Fontan, Paganin Gorge, oozing cliff, 530 m, 21 Mar 2012, *Pires F12-I8* (CBNMED); France, Alpes-Maritimes, Fontan, Chiapères Valley, wet cliff, 750 m, 22 Mar 2012, *Pires F12-I5* (CBNMED); France, Alpes-Maritimes, Fontan, under Bergue, oozing cliff, 550 m, 22 Mar 2012, *Pires F12-I7* (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-I6* (CBNMED); Italy, Liguria, Cisano sul Neva, Vale Ibà, wet cliff, 437 m, 11 May 2012, *Pires F12-I4* (CBNMED) [Fig. 1B].

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 ($2n = 32$) 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.

$2n = 64$, CHN. France, Alpes-Maritimes, Saorge, Gorges de Bendola, Castou Bridge, wet rock along the river, 430 m, 21 Mar 2012, *Pires F12-I3* (CBNMED) [Fig. 1C].

For this widespread species, some earlier studies reported $2n = 50$ (e.g., Tischler, 1934), whereas $2n = 64$ 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).

Literature cited

- Bayon, E. 1989. Números cromosómicos de plantas occidentales 508–520. *Anales Jard. Bot. Madrid* 45: 495–500.
- Casper, S.J. & Stimper, R. 2006. New and revised chromosome numbers in *Pinguicula* (Lentibulariaceae). *Haussknechtia* 11: 3–8.
- Casper, S.J. & Stimper, R. 2009. Chromosome numbers in *Pinguicula* (Lentibulariaceae) survey, atlas, and taxonomic conclusions. *Pl. Syst. Evol.* 227: 21–60. <http://dx.doi.org/10.1007/s00606-008-0097-9>
- Contandriopoulos, J. & Quézel, P. 1974. A propos de l'étude caryologique de quelques *Pinguicula* de Grèce et de Turquie, et en particulier du complexe *Pinguicula hirtiflora* Ten. *Biol. Écol. Médit.* 1: 27–31.
- Doulat, E. 1947. Recherches caryologiques sur quelques *Pinguicula*. *Compt. Rend. Hebd. Séances Acad. Sci., Ser. D* 225: 354–356.
- Honsell, E. 1959. Ricerche citotassonomiche su *Pinguicula hirtiflora* Ten. *Ann. Bot. (Roma)* 26: 177–188.
- Löve, A. & Löve, D. 1944. Cytotaxonomical studies on boreal plants. III. Some new chromosome numbers of Scandinavian plants. *Ark. Bot.* 31 A(12):1–23.
- Mikeladse, T. & Casper, S.J. 1997. Der *crystallina-hirtiflora*-Sippenkomplex in der Gattung *Pinguicula* L. *Haussknechtia* 7: 39–40.
- Peruzzi, L., Passalacqua, N.G. & Cesca, G. 2004. *Pinguicula crystallina* Sibth. et Smith subsp. *hirtiflora* (Ten.) Strid (Lentibulariaceae) in Calabria (South Italy). Cytotaxonomical study and ex situ conservation in the Botanic Garden of Calabria University. *Carniv. Pl. Newslett.* 33(3): 68–74.
- Sokolovskaya, A.P. 1972. Karyologicheskaya kharakteristika predstavitelei flory Leningradskoi oblasti. *Vestn. Leningradsk. Univ., Ser. Biol.* 21/4: 56–63.
- Strid, A. & Franzén, R. 1981. Chromosome numbers in plants of Mt Olympus. In: Löve, A. (ed.), IOPB chromosome number reports LXXIII. *Taxon* 30: 829–842. <http://www.jstor.org/stable/1220093>
- Tischler, G. 1934. Die Bedeutungen der Polyploidie für die Verbreitung der Angiospermen, erläutert an den Arten Schleswig-Holsteins, mit Ausblicken auf andere Florengebiete. *Bot. Jahrb. Syst.* 67: 1–36.
- Ubera, J.L. 1983. Números cromosómicos para la flora Española, 263–269. *Lagascalia* 12: 119–122.
- Valdes-Bermejo, E. & Sanchez Crespo, A. 1978. Datos cariológicos y taxonómicos sobre el género *Teucrium* L. (Labiatae). *Acta Bot. Malac.* 4: 27–54.
- Wood, C.E. & Godfrey, R.K. 1957. *Pinguicula* (Lentibulariaceae) in the southeastern United States. *Rhodora* 59(705): 217–230.

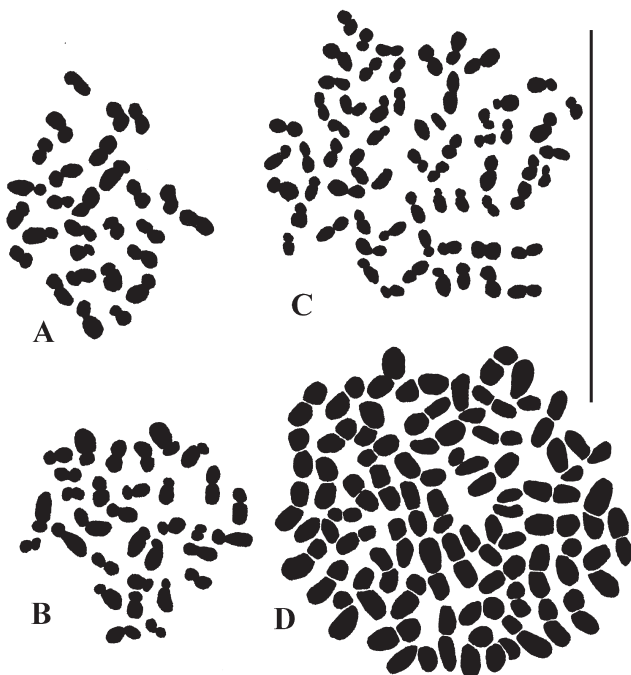


Fig. 1. Somatic metaphase. **A**, *Pinguicula hirtiflora*, $2n = 28$; **B**, *Pinguicula reichenbachiana*, $2n = 32$; **C**, *Pinguicula* cf. *vulgaris*, $2n = 64$; **D**, *Teucrium pseudochamaepitys*, $2n = 60$. — Scale bar = $10\ \mu\text{m}$

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** New chromosome number for the species.

VALERIANACEAE

** *Nardostachys grandiflora* DC.

$n = 39$, $2n = 78$, 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 $2n = 26$ 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.

Literature cited

Goldblatt, P. 1984. Index to Plant Chromosome Numbers, 1979–1981. *Syst. Bot. Monogr.* 8: 1–427.

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* First chromosome count for the species.

** New chromosome number (cytotype) for the species.

▼ First chromosome count from an Indian accession.

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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 $2n = 18$ (Chouksanova & al., 1968; Garcia & al., 2009) from outside of India. From outside of India also $2n = 10$ 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 $2n = 58$ (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 ($2n = 34$) 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 ($2n = 24$, 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 $2n = 24$ (Khattoon & 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 ($2n = 24$) 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 $2n = 18$ (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 $2n = 20$ (Jee & al., 1985; Jee & al., 1989) and tetraploid chromosome number $2n = 40$ (Mehra & Gill, 1968) were reported for this species from India.

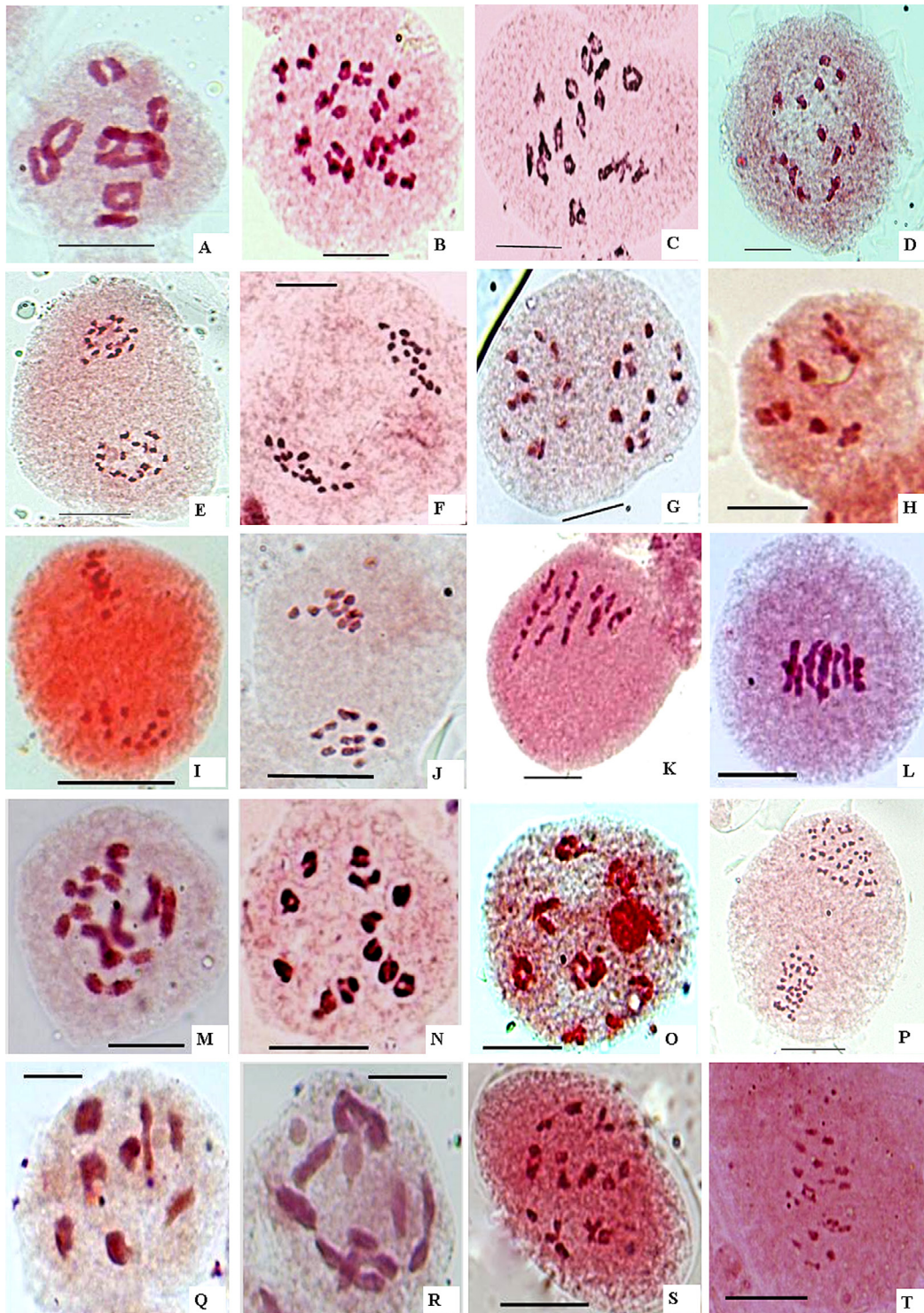


Fig. 1. **A**, *Aster himalaicus*, PMC at Diakinesis, $n = 9$ (PUP 59499); **B**, *Cremanthodium ellisii*, PMC at Metaphase, $n = 29$ (PUP 59647); **C**, *Saussurea auriculata*, PMC at Diakinesis, $n = 16$ (PUP 59656); **D**, *Saussurea piptathera*, PMC at Metaphase I, $n = 13$ (PUP 59652); **E**, *Saussurea 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, $n = 14$ (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 Metaphase 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 $2n = 22$ 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 $2n = 22$ from outside India (Tischler, 1950; Reese, 1952) and a second one with $2n = 44$ 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, $2n = 16$ (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, $2n = 14$ (Yamashita, 1937) and $2n = 16$ (Hofelich, 1935) were reported for this species.

Literature cited

Bala, S. & Gupta, R.C. 2011. [Report] in: Marhold, K. (ed.), IAPT/IOPB Chromosome data 12. *Taxon* 60: 1784–1786, E2–E16.
 Britton, D.M. 1951. Cytological studies on the Boraginaceae. *Brittonia* 7: 233–266. <http://dx.doi.org/10.2307/2804694>

Chouksanova, N.A., Sveshnikova, L.I. & Alexandrova, T.V. 1968. Data on karyology of the family Compositae Giseke. *Citologija* 10: 198–206.
 Garcia, S., Lim, K.Y., Chester, M., Garnatje, T., Pellicer, J., Valles, J., Leitsch, A.R. & Kovarik, A. 2009. Linkage of 35S and 5S rRNA genes in *Artemisia* (family Asteraceae): First evidence from angiosperms. *Chromosoma* 118: 85–97. <http://dx.doi.org/10.1007/s00412-008-0179-z>
 Hofelich, A. 1935. Die Sektion *Alsinebe* Griseb. der Gattung *Veronica* in ihren chromosomalen Grundlagen. *Jahrb. Wiss. Bot.* 15: 541–572.
 Jee, V., Dhar, U. & Kachroo, P. 1985. Chromosomal conspectus of some alpine-subalpine taxa of Kashmir Himalaya. *Chromosome Inform. Serv.* 39: 33–35.
 Jee, V., Dhar, U. & Kachroo, P. 1989. Cytogeography of some endemic taxa of Kashmir Himalaya. *Proc. Indian Natl. Sci. Acad., B* 55: 177–184.
 Khatoon, S. & Ali, S.I. 1993. *Chromosome atlas of the angiosperms of Pakistan*. Karachi: Department of Botany, University of Karachi.
 Kress, A. 1969. Zytotaxonomische Untersuchungen an Primulaceen. *Phyton (Horn)* 13: 211–225.
 Krogulevich, R.E. 1976. Rol' poliploidii v genezise flory Putorana. Pp. 217–235 in: Malyshev, L.I. (ed.), *Flora Putorana: Materiali k poznaniyu osobennosti sostava i genezisa gornyykh subarkticheskikh flor Sibiri*. Novosibirsk: Nauka.
 Krogulevich, R.E. 1978. Kariologicheskii analiz vidov flory Vostochnogo Sayana. Pp. 19–48 in: Malyshev, L.I. & Peshkova, G.A. (eds.): *Flora Pribajkal'ja*. Novosibirsk: Nauka.
 Liu, J., Liu, S., Ho, T. & Lu, A. 2001. Karyological studies on the Sino-Himalayan genus, *Cremanthodium* (Asteraceae: Senecioneae). *Bot. J. Linn. Soc.* 135: 107–112. <http://dx.doi.org/10.1111/j.1095-8339.2001.tb01085.x>
 Malik, R.A. & Gupta, R.C. 2013. Meiotic studies in some selected members of Gamopetalae from Kashmir Himalaya. *Pl. Syst. Evol.* 299: 1549–1560. <http://dx.doi.org/10.1007/s00606-013-0818-6>
 Mehra, P.N. & Gill, L.S. 1968. Chromosome number reports XVI. *Taxon* 17: 202–203. <http://www.jstor.org/stable/1216516>
 Mehra, P.N. & Vasudevan, K.N. 1972. [Report] in: Löve, Á. (ed.), IOPB chromosome number reports XXXVI. *Taxon* 21: 341–344. <http://www.jstor.org/stable/1218208>
 Murín, A., Háberová, I. & Žamsran, C. 1984. Further karyological studies of the Mongolian flora. *Folia Geobot. Phytotax.* 19: 28–39. <http://dx.doi.org/10.1007/BF02853327>
 Reese, G. 1952. Ergänzende Mitteilungen über die Chromosomenzahlen mitteleuropäischer Gefäßpflanzen, 1. *Ber. Deutsch. Bot. Ges.* 64: 240–255.
 Sarkar, A.K. 1988. Primulaceae – Its evolution and assessment in status as judged through cytotaxonomy. *Feddes Repert.* 99: 113–132.
 Tischler, G. 1950. *Die Chromosomenzahlen der Gefäßpflanzen Mitteleuropas*. The Hague: Dr. W. Junk. <http://dx.doi.org/10.1007/978-94-011-5958-6>
 Tornadore, N., Bonomi, M., Marcucci, R., Barcaccia, G., Parrini, P. & Lucchin, M. 2003. Morphological, karyological and molecular analysis in *Aster* spp. (Asteraceae). *Israel J. Pl. Sci.* 51: 109–119. <http://dx.doi.org/10.1560/M5P1-CB91-DTRR-16T1>
 Vasudevan, K.N. 1975. Contribution to the cytotaxonomy and cytogeography of the flora of the western Himalayas (with an attempt to compare it with the flora of the Alps). Part II. *Ber. Schweiz. Bot. Ges.* 85: 210–252.
 Yamashita, K. 1937. Chromosomenzahlen einiger *Veronica* Arten. *Agric. & Hort.* 12: 1219–1220.