


























IAPT CHROMOSOME DATA

IAPT chromosome data 33

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IAPT chromosome data 33/1

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All materials CHN; collected in India; collector: JA = Jaya Arora; vouchers in DUH.

BALSAMINACEAE

Impatiens devendrae Pusalkar, $2n = 14$; India, Western Himalaya, Uttarakhand, JA 2551.

Impatiens sulcata Wall., $2n = 20$; India, Western Himalaya, Uttarakhand, JA 2558.

GERANIACEAE

Geranium robertianum L., $2n = 52$; India, Western Himalaya, Uttarakhand, JA 2553.

Geranium wallichianum D. Don ex Sweet, $2n = 26$; India, Western Himalaya, Uttarakhand, JA 2555.

RANUNCULACEAE

Thalictrum cultratum Wall., $2n = 14$; India, Western Himalaya, Uttarakhand, JA 2554.

Thalictrum elegans Wall. ex Royle, $2n = 14$; India, Western Himalaya, Uttarakhand, JA 2557.

Thalictrum foliolosum DC., $2n = 14$; India, Western Himalaya, Uttarakhand, JA 2556.

IAPT chromosome data 33/2

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Aperfeiçoamento de Pessoal de Nível Superior), and INSA (Instituto Nacional do Semiárido).

All materials CHN; vouchers in EAN (Herbarium Jayme Coelho de Moraes).

ACANTHACEAE

Subfamily Acanthoideae

Tribe Justicieae

Dicliptera mucronifolia Nees, $2n = 80$; Brazil, Paraíba, J.M.P. Cordeiro 1020.

Harpochilus neesianus Mart. ex Nees, $2n = 28$; Brazil, Paraíba, J.M.P. Cordeiro 1399.

Justicia aequilabris (Nees) Lindau, $2n = 28$; Brazil, Paraíba, L.P. Felix 15922.

Justicia birae A.S.Reis, F.A.Silva, A.Gil & Kameyama, $2n = 28$; Brazil, Pará, L.P. Felix 15982.

Justicia chamaedryoides (Nees) Wassh. ex A.L.A.Côrtes & P.L.R. Moraes, $2n = 18$; Brazil, Paraíba, J.M.P. Cordeiro 1041.

Tribe Ruellieae

Hygrophila paraibana Rizzini, $2n = 60$; Brazil, Pernambuco, L.P. Felix 15979.

Ruellia asperula (Mart. & Nees) Lindau, $2n = 34$; Brazil, Paraíba, L.P. Felix 15923.

Ruellia bahiensis Morong, $2n = 34$; Brazil, Paraíba, J.M.P. Cordeiro 1476.

Ruellia cearensis Lindau, $2n = 34$; Brazil, Pernambuco, L.P. Felix 15995.

Ruellia geminiflora Kunth, $2n = 34$; Brazil, Pernambuco, L.P. Felix 15990.

Ruellia inundata Kunth, $2n = 34$; Brazil, Paraíba, J.M.P. Cordeiro 1477.

Ruellia ochroleuca Mart. ex Nees, $2n = 34$; Brazil, Paraíba, J.M.P. Cordeiro 1199.

Ruellia paniculata Kunth, $2n = 34$; Brazil, Pernambuco, L.P. Felix 15978.

Ruellia simplex C.Wright, $2n = 34$; Brazil, Paraíba, J.M.P. Cordeiro 1478.

Subfamily Nelsonioideae

Elytraria imbricata (Vahl) Pers., $2n = 24$; Brazil, Paraíba, J.M.P. Cordeiro 1052.

Nelsonia canescens (Lam.) Spreng., $2n = 72$; Brazil, Paraíba, J.M.P. Cordeiro 1474.

IAPT chromosome data 33/3

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OROBANCHACEAE

Melampyrum arvense L., $2n = 18$; Austria, DA, LD 545, MO, JASA & ER (SALA 118392), LD 947, MO, LMC & MS (SALA 134801); Romania, XG 75, MO & JASA (SALA 102559).

Melampyrum barbatum Waldst. & Kit. ex Willd., $n = 9$, $2n = 18$; Romania, XG 76, MO & JASA (SALA 102560). $2n = 18$; Austria, DA, LD 528, MO, JASA & ER (SALA 118377).

Melampyrum italicum Soó, $2n = 18$; Italy, AH 1927 & al. (SALA 134806).

Melampyrum pratense L., $2n = 18$; Austria, DA, LD, MO, JASA & ER 7534 (SALA 118113).

Melampyrum sylvaticum L., $2n = 18$; Austria, DA, LD, MO, JASA 116 & ER (SALA 118166); France, LD, MO 912, JASA & ER (SALA 117978).

Melampyrum vaudense (Ronniger) Sóo, $2n = 18$; France, LD 948, MO, LMC & MS (SALA 134802).

Pedicularis acmodonta Boiss., $n = 8$, $2n = 16$; Armenia, AH 2582 & al. (SALA 134804), LM 2521 & al. (SALA 134812). $2n = 16$; Armenia, CA 11590 (SALA 134808); Turkey, SN 708 & al. (SALA 120484).

Pedicularis aspleniifolia Flörke ex Willd., $2n = 16$; Austria, AT 4560 & al. (SALA 123300).

Pedicularis atropurpurea Nordm., $2n = 16$; Turkey, SN 896 & al. (SALA 120596).

Pedicularis cenisia Gaudin, $2n = 16$; France, LD, MO 941, JASA & ER (SALA 118007).

Pedicularis comosa subsp. *asparagoides* (Lapeyr.) P.Fourn., $2n = 16$; France, MG & al. (SALA 110784).

Pedicularis comosa L. subsp. *comosa*, $2n = 16$; Italy, CA 8317 & al. (MA 699688); Spain, LD 231 & MO (SALA 110782), LD 346 & IS (SALA 110783).

Pedicularis condensata M.Bieb., $2n = 16$; Armenia, CA 11739 & al. (SALA 134811), SC & al. 17702 (SALA 134813).

Pedicularis elegans subsp. *praetutiana* (Steininger) Pign. Wik., $2n = 16$; Italy, CA 8308 & al. (SALA 134810).

Pedicularis elongata A.Kern., $2n = 16$; Italy, LD, MO, JASA & ER 7642 (SALA 118546), LD, MO, JASA & ER 7668 (SALA 118573).

Pedicularis foliosa L., $n = 8$, $2n = 16$; Spain, SB, LD 76 & JASA (SALA110814). $2n = 16$; Spain, LD 341 & IS (SALA 110813).

Pedicularis graeca Bunge, $2n = 16$; Greece, SC 18338 & al. (SALA 134814).

Pedicularis hoermanniana K.Malý, $2n = 16$; Bulgaria, CA 10417 & al. (SALA 134807).

Pedicularis kerneri Dalla Torre, $n = 8$, $2n = 16$; Spain, LD 348 & IS (SALA 110799).

Pedicularis mixta Gren., $n = 8$, $2n = 16$; Spain, LD 280 & MO (SALA 110810), LD 282 & MO (SALA 110811). $2n = 16$; Spain, LD 777 & ER (SALA 110808), LD 343 & IS (SALA 110809), IS 98127 & MG (BCN 10514), PB & ER (SALA 110807).

Pedicularis nordmanniana Bunge, $2n = 16$; Turkey, *SN 792* & *al.* (SALA 120528).

Pedicularis orthantha Griseb., $2n = 16$; Bulgaria, *MLA 207* & *al.* (SALA 134817), *MLA 279* & *al.* (SALA 134816).

Pedicularis pontica Boiss., $2n = 16$; Turkey, *SN 860* & *al.* (SALA 120572).

Pedicularis pyrenaica var. *fallax* Font Quer & Guinea, $2n = 16$; Spain, *LD 797* (SALA 110806).

Pedicularis pyrenaica J.Gay subsp. *pyrenaica*, $2n = 16$; Spain, *LD 281* & *MO* (SALA 110805), *LD 330* & *IS* (SALA 110801), *LD 320* & *IS* (SALA 110803), *SB, LD 73* & *JASA* (SALA 110804), *LD 345* & *IS* (SALA 110802), *LD 336* & *IS* (SALA 110800).

Pedicularis rosea subsp. *allionii* (Rchb.f.) E.Mayer, $2n = 16$; Spain, *LD 347* & *IS* (SALA 110815).

Pedicularis rostratocapitata Crantz, $2n = 16$; Austria, *DA, LD, MO, JASA* & *ER 7548* (SALA 118456); Italy, *LD, MO, JASA* & *ER 7641* (SALA 118544), *LD, MO, JASA* & *ER 7651* (SALA 118555).

Pedicularis schizocalyx (Lange) Steininger, $n = 16$; Spain, *LD 312* & *MO* (SALA 110787). $n = 16$, $2n = 32$; Spain, *LD 301, KM* & *MO* (SALA 110790). $2n = 32$; Spain, *LD* & *ER 6601* (SALA 110786), *LD 161* (SALA 110788), *LD 203* & *MO* (SALA 110785), *LD 762* (SALA 110789), *LD, MO 627* & *JASA* (SALA 110792), *PB* & *LD 824* (SALA 110791), *PB* & *LD 825* (SALA 110793).

Pedicularis sibthorpii Boiss., $2n = 16$; Turkey, *CA 6154* & *al.* (SALA 119845).

Pedicularis sylvatica subsp. *lusitanica* (Hoffmanns. & Link) Cout., $2n = 16$; Spain, *FA, SB, LD 119, ER* & *JASR* (SALA 110780), *LD 34-4, XG* & *ER* (SALA 110779), *LD* & *MO 6283* (SALA 110781).

Pedicularis sylvatica L. subsp. *sylvatica*, $2n = 16$; Spain, *LD 162* (SALA 110776), *LD 15, ER, JASR* & *CV* (SALA 110775), *LD 300, KM, ER* & *JASA* (SALA 110777), *LD 270* & *MO* (SALA 110778), *LD 270* & *MO* (SALA 110778), *LD 44, JH, MO* & *ER* (SALA 110774).

Pedicularis tuberosa L., $2n = 16$; Spain, *LD 324* & *IS* (SALA 110794), *LD 329* & *IS* (SALA 110795), *LD 334* & *IS* (SALA 110798).

Pedicularis verticillata subsp. *caespitosa* (Webb) I.Soriano, $2n = 12$; Spain, *ER* & *MS 925* (SALA 134815).

Pedicularis verticillata L. subsp. *verticillata*, $n = 6$, $2n = 12$; Spain, *LD 230* & *MO* (SALA 110816), *LD 22, ER, JASR* & *CV* (SALA 110818). $2n = 12$; Italy, *CA 8288* & *al.* (SALA 135318), *LD, MO, JASA* & *ER 7660* (SALA 118565); Spain, *LD 318* & *MO* (SALA 110819), *LD 14, ER, JASR* & *CV* (SALA 110817).

Rhinanthus alectorolophus (Scop.) Pollich, $2n = 14$, $2n = 14 + 8B$; France, *LD, MO 937, JASA* & *ER* (SALA 118003).

Rhinanthus glacialis Personnat, $n = 7$, $2n = 14$; Austria, *DA, LD, MO, JASA 115* & *ER* (SALA 118165). $2n = 14$; Austria, *LD 561, MO, JASA* & *ER* (SALA 118410).

Rhinanthus minor L., $n = 7$; Italy, *LD 375, MO, JASA* & *ER* (SALA 118236).

Naturally occurring interspecific hybrids

Pedicularis mixta Gren. \times *P. praetermissa* (I.Soriano, M.Bernal & A.Sánchez-Cux.) Aymerich & L.Sáez (*P. \times aranensis* I.Soriano), $2n = 16$; Spain, *LD 353* & *IS* (SALA 110820).

Pedicularis pyrenaica J.Gay \times *P. tuberosa* L. (*P. \times pallidiflora* I.Soriano), $2n = 16$; *LD 325* & *IS* (SALA 110797), *LD 326* & *IS* (SALA 110796), *LD 335* & *IS* (SALA 110821).

IAPT chromosome data 33/4

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All materials CHN.

CYPERACEAE

Subfamily Cyperoideae

Becquerelia cymosa Brongn., $2n = 40$; Brazil, Paraíba, *E.M. Almeida 2856* & *M. Fernandes* (EAN 29294).

Subfamily Mapanioideae

Diplasia karatifolia Rich., $2n = 60$; Brazil, Amazonas, *M. Alves & Y. Dias 04-2018* (UFP).

Hypolytrum schraderianum Nees, $2n = 60$; Brazil, Amazonas, *M. Alves & Y. Dias 05-2018* (UFP); Brazil, Bahia, *W.W. Thomas, P.J.S. Silva Filho & L.H. Daneu 16811* (JPB, NYBG); $2n = 76$; Brazil, Paraná, *M.C. Dias & E. Rocha s.n.* (FUEL 29197, HCF 9642, VIES 26685).

THURNIACEAE

Prionium serratum (L.f.) Drège ex E.Mey., $2n = 46$; South Africa, Western Cape, *T.L. Elliott TE2016_413* (BOL).

Thurnia sphaerocephala (Rudge) Hook.f., $2n = 46$; Brazil, Amazonas, *M. Alves & Y. Dias 10-2018* (UFP).

IAPT chromosome data 33/5

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All materials CHN.

FABACEAE (LEGUMINOSAE)

- Caragana grandiflora* DC., $2n = 16$; Russia, Kabardino-Balkaria Republic, R.A. Murtazaliev 58881 (IRK).
Galega orientalis Lam., $2n = 16$; Russia, Kabardino-Balkaria Republic, D.A. Krivenko 59068 (IRK).
Vavilovia formosa (Steven) Fed. (= *Pisum formosum* (Steven) Alef.), $2n = 14$; Russia, Republic of Dagestan, D.A. Krivenko, Z.A. Guseinova & R.A. Murtazaliev 58156 (IRK, TASH).
Vicia hololasia Woronow, $2n = 10$; Russia, Republic of Dagestan, R.A. Murtazaliev s.n. (DAG).

LILIACEAE

- Tulipa mongolica* Y.Z.Zhao, $2n = 24$; Russia, Zabaikalskii Krai, O.A. Chernysheva, L.I. Sarajeva, A.S. Erst, E.R. Khadeeva & D.A. Krivenko 53652 (IRK).
Tulipa uniflora (L.) Besser ex Baker, $2n = 24$; Russia, Irkutskaya Oblast', O.A. Chernysheva & D.A. Krivenko 48972 (IRK, MW), O.A. Chernysheva & D.A. Krivenko 48966 (IRK, LE), O.A. Chernysheva & D.A. Krivenko 48976 (IRK), O.A. Chernysheva & D.A. Krivenko 48978 (IRK).

RANUNCULACEAE

- Adonis sibirica* Patrin ex Ledeb., $2n = 24$; Russia, Irkutskaya Oblast', O.A. Chernysheva 59064 (IRK, NS).
Anemone caerulea DC. (= *Anemonoides caerulea* (DC.) Holub), $2n = 16$; Russia, Republic of Altai, A.S. Erst, T.V. Erst & E.V. Boltenkov 09 (NS).
Anemone sylvestris L. (= *Anemonoides sylvestris* (L.) Galasso, Banfi & Soldano), $2n = 16$; Russia, Novosibirskaya Oblast', 17 May 2020, A.S. Erst & T.V. Erst s.n. (NS).
Callianthemum angustifolium Witasek, $2n = 16$; Russia, Republic of Altai, A.S. Erst 439 (NS).
Eranthis bulgarica (Stef.) Stef., $2n = 16$; Bulgaria, A. Tashev 001 (SOM).
Eranthis byusanensis B.Y.Sun., $2n = 16$; South Korea, H. Ikeda, H.-T. Im, K.-S. Chung, M. Fujii, M. Sakamoto & C. Hasekura 19032401 (NS).
Eranthis cilicica Schott & Kotschy, $2n = 16$; Turkey, T. Ertuğrul 1062 (GAZI).
Eranthis hyemalis (L.) Salisb., $2n = 16$; Italy, A.S. Erst, T.V. Erst & L. Pinzani 005 (NS).
Eranthis pinnatifida Maxim., $2n = 16$; Japan, A.S. Erst, T.V. Erst & H. Ikeda 001 (NS), A.S. Erst, T.V. Erst & H. Ikeda 002 (NS), A.S. Erst, T.V. Erst & H. Ikeda 005 (NS), A.S. Erst, T.V. Erst & H. Ikeda 006 (NS).
Eranthis stellata Maxim., $2n = 16$; P. R. China, Jilin Province, K. Xiang 001 (PE); Russia, Amurskaya Oblast', T.N. Veklich 001 (NS).
Trollius austrosibiricus Erst & Lufarov, $2n = 16$; Russia, Republic of Altai, A.S. Erst, T.V. Erst & E.V. Boltenkov 036 (NS).
Trollius chinensis Bunge, $2n = 16$; Russia, Primorskii Krai, V. Yakubov 001; Russia, Primorskii Krai, M. Koldaeva 001 (NS).
Trollius irtuticus Sipliv., $2n = 16$; Russia, Irkutskaya Oblast', O.A. Chernysheva 59078 (IRK, NS); Russia, Republic of Buryatiya, A.S. Erst, E.Yu. Mitrenina, D.A. Krivenko & O.A. Chernysheva 122 (NS).
Trollius riederianus Fisch. & C.A.Mey., $2n = 16$; Russia, Amurskaya Oblast', T.N. Veklich 002 (NS); Russia, Sakhalinskaya Oblast', O.M. Potseluev 001 (NS).

IAPT chromosome data 33/6

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All materials CHN; collectors: AC = A. Calvente; LMV = L.M. Versieux.

CACTACEAE

- Lepismium cruciforme* (Vell.) Miq., $2n = 22$; Brazil, Rio de Janeiro, AC, T.C. Lopes & E. Saggi 26 (RB); Brazil, São Paulo, AC 195 (SPF).
Rhipsalis agudoensis N.P.Taylor, $2n = 22$; Brazil, Rio Grande do Sul, Horst-Uebelmann 821 (living collection Kew 2003-3061, K).
Rhipsalis cereoides (Backeb. & Voll) A.Cast., $2n = 22$; Brazil, Rio de Janeiro, A.A.M. Barros, D.C. Zappi, AC, B.R. Silva & D.G. Matuano 2302 (RB).
Rhipsalis crispata (Haw.) Pfeiff., $2n = 22$; Brazil, São Paulo, AC & LMV 215 (SPF), AC & LMV 366 (SPF).
Rhipsalis cuneata Britton & Rose, $2n = 44$; Ecuador, Zamora-Chinchipe, AC & LMV 381 (SPF).
Rhipsalis elliptica G.Lindb. ex K.Schum., $2n = 22$; Brazil, Rio de Janeiro, AC & LMV 96 (RB); Brazil, Bahia, AC & LMV 320 (RB).
Rhipsalis hileiabaiana (N.P.Taylor & Barthlott) N.Korotkova & Barthlott, $2n = 44$; Brazil, Bahia, AC & LMV 321 (SPF).
Rhipsalis mesembryanthemoides Haw., $2n = 22$; Brazil, Rio de Janeiro, M.F. Freitas & AC 458 (RB).
Rhipsalis micrantha (Kunth) DC., $2n = 22$; Ecuador, El Oro, AC & LMV 388a (SPF). $2n = 44$; Peru, Cajamarca, AC & LMV 395 (SPF).
Rhipsalis neves-armondii K.Schum., $2n = 22$; Brazil, Espírito Santo, LMV 195 (UFRN).
Rhipsalis paradoxa subsp. *septentrionalis* N.P.Taylor & Barthlott, $2n = 22$; Brazil, Bahia, AC & LMV 312 (SPF).
Rhipsalis pentaptera A.Dietr., $2n = 22$; Brazil, Rio de Janeiro, AC & C.H.R. de Paula 121 (SPF).
Rhipsalis pilocarpa Loefgr., $2n = 22$; Brazil, Rio de Janeiro, AC 72 (SP).
Rhipsalis pulchra Loefgr., $2n = 22$; Brazil, Rio de Janeiro, AC & LMV 334 (SPF).
Rhipsalis russellii Britton & Rose, $2n = 22$; Brazil, Minas Gerais, D.C. Zappi 195 (SPF).
Rhipsalis teres f. *heteroclada* (Britton & Rose) Barthlott & N.P.Taylor, $2n = 22$; Brazil, Rio de Janeiro, AC & LMV 86 (RB).
Rhipsalis triangularis Werderm., $2n = 22$; Brazil, Rio de Janeiro, AC & LMV 89 (RB).
Rhipsalis trigona Pfeiff., $2n = 22$; Brazil, São Paulo, AC 404 (UFRN).

IAPT chromosome data 33/7

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All materials CHN; collectors: *D* = J.R. Daviña, *GIA* = A.C. Gianini Aquino, *H* = A.I. Honfi; vouchers at MNES.

AMARYLLIDACEAE

Habranthus andalgalensis Ravenna, *n* = 6II, *2n* = 12; Argentina, Misiones, *H* 1921.

Habranthus chacoensis Ravenna, *2n* = 12 + 2B, Argentina, Chaco, *D* 661. *n* = 6, *2n* = 12; Argentina, Corrientes, *H* 2246.

Habranthus pedunculatus Herb., *2n* = 14; Argentina, Misiones, *D* 678, *GIA* 17, *GIA* 50, *H* 1919; Argentina, Corrientes, *D* 622, *H* 2120B, *GIA* 3, *H* 1738, *H* 2118B, *H* 2244; Argentina, Santa Fe, *H* 2335.

Habranthus robustus Herb., *2n* = 12; Argentina, Misiones, *D* 641, *GIA* 51, *GIA* 52, *GIA* 53, *GIA* 55, *H* 1338, *H* 2158. *n* = 6II, *2n* = 12; Argentina, Misiones, *GIA* 6.

IAPT chromosome data 33/8

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Chromosome numbers counted by M. Lomonosova; DNA ploidy levels estimated by T. An'kova; collectors: *JA* = J. Akopian, *KE* = Kh. Esanov, *OT* = O. Turginov, *REM* = R. El Mokni.

AMARANTHACEAE

Atriplex micrantha C.A.Mey., *2n* = 4x = 36, CHN. Uzbekistan, Bukhara Region, 23 Oct 2019, *KE s.n.* (NS). *2n* ≈ 4x ≈ 36, 2C = 3.74–4.12 pg, FCM. Uzbekistan, Bukhara Region, 23 Oct 2019, *KE s.n.* (NS).

Atriplex tatarica L., *2n* = 2x = 18, CHN. Uzbekistan, Bukhara Region, 23 Oct 2019, *KE s.n.* (NS). *2n* ≈ 2x ≈ 18, 2C = 1.25–1.27 pg, FCM. Uzbekistan, Bukhara Region, 23 Oct 2019, *KE s.n.* (NS).

Chenopodium betaceum Andr., *2n* = 2x = 36, CHN. Uzbekistan, Bukhara Region, 23 Oct 2019, *KE s.n.* (NS).

Climacoptera amblyostegia Botsch., *2n* = 2x = 18, CHN. Uzbekistan, Namangan Region, 15 Nov 2019, *OT s.n.* (NS).

Girgensonia diptera Bunge, *2n* = 8x = 72, CHN. Uzbekistan, Namangan Region, 15 Nov 2019, *OT s.n.* (NS).

Suaeda altissima (L.) Pall., *2n* = 2x = 18, CHN. Republic of Armenia, 18 Oct 2014, *JA s.n.* (NS).

Suaeda arcuata Bunge, *2n* = 2x = 18, CHN. Uzbekistan, Bukhara Region, 23 Oct 2019, *KE s.n.* (NS).

Suaeda heterophylla (Kar. & Kir.) Bunge, *2n* = 2x = 18, CHN. Republic of Armenia, Ararat Province, 9 Sep 2017, *JA 1* (ERE, NS).

Suaeda salsa (L.) Pall., *2n* = 4x = 36, CHN. Republic of Armenia, Ararat Province, 9 Sep 2017, *JA 2* (ERE, NS).

Suaeda spicata (Willd.) Moq., *2n* = 4x = 36, CHN. Tunisia, Kheniss (Monastir Governorate), 10 Nov 2017, *REM s.n.* (NS).

IAPT chromosome data 33/9

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All materials CHN.

PTERIDACEAE/CHEILANTHOIDEAE

Adiantopsis chlorophylla (Sw.) Fée, *2n* = 60; Argentina, Jujuy, Morero & al. 511 (CORD).

Adiantopsis radiata (L.) Fée, *2n* = 60; Argentina, Misiones, Morero & Meza Torres 518 (CORD).

Adiantopsis tweediana (Hook.) Link-Pérez & Hickey, *2n* = 60; Argentina, Córdoba, Morero 521 (CORD).

Argyrosma flava (Hook.) M.Kessler & A.R.Sm., *2n* = 54; Argentina, Córdoba, Morero 435 (CORD).

Argyrosma nivea (Poir.) Windham var. *nivea*, *2n* = 54; Argentina, Córdoba, Morero 450 (CORD).

Argyrosma tenera (Gillies ex Hook.) M.Kessler & A.R.Sm., *2n* = 54; Argentina, Córdoba, Morero 517 (CORD).

Astrolepis sinuata (Lag. ex Sw.) D.M.Benham & Windham, *2n* = 87; Argentina, Jujuy, Morero & al. 509 (CORD).

Cheilanthes buchtienii (Rosenst.) R.M.Tryon, *2n* = 60; Argentina, Córdoba, Morero 403 (CORD).

Cheilanthes glauca (Cav.) Mett., *2n* = 60; Argentina, Chubut, Morero & Vidoz 519 (CORD).

Cheilanthes hieronymi Herter, *n* = 60; Argentina, Buenos Aires, Arana s.n. (SI).

Cheilanthes micropteris Sw., *2n* = 120; Argentina, Córdoba, Morero & Li 445 (CORD).

Cheilanthes obducta Mett. ex Kuhn, *2n* = 60; Argentina, Jujuy, Morero & al. 505 (CORD).

Cheilanthes pilosa Goldm., *2n* = 120; Argentina, Jujuy, Morero & al. 508 (CORD).

Cheilanthes pruinata Kaulf., *2n* = 90; Argentina, Córdoba, Morero 428 (CORD).

Cheilanthes squamosa Gillies ex Hook. & Grev., *2n* = 60; Argentina, Córdoba, Morero 520 (CORD).

Doryopteris adornata Yesilyurt, *2n* = 60; Argentina, Jujuy, Morero & al. 512 (CORD).

Doryopteris concolor (Langsd. & Fisch.) Kuhn & Decken, $2n = 60$; Argentina, Jujuy, *Moreno & al.* 513 (CORD).
Gaga marginata (Kunth) Fay W.Li & Windham, $2n = 90$; Argentina, Córdoba, *Moreno 151* (CORD).
Myriopteris aurea (Poir.) Grusz & Windham, $2n = 90$; Argentina, Jujuy, *Moreno & al.* 501 (CORD).
Myriopteris myriophylla (Desv.) J.Sm., $2n = 90$; Argentina, Córdoba, *Moreno 453* (CORD).
Pellaea ovata (Desv.) Weath., $2n = 87$; Argentina, Salta, *Moreno & al.* 498 (CORD).
Pellaea ternifolia (Cav.) Link, $2n = 116$; Argentina, Córdoba, *Moreno 65* (CORD).

IAPT chromosome data 33/10

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All materials CHN; collected in the P. R. China, Sichuan; collectors: MO = Marina Olonova, YSC = Yousheng Chen; * indicates mixoploidy.

POACEAE

Poa faberi Rendle, $2n = 28$, 35*; YSC & MO s.n. (TK 15-91, PE).
Poa incerta Keng ex L.Liu, $2n = 28$; YSC & MO s.n. (TK 15-119, PE), YSC & MO s.n. (TK 15-137, PE). $2n = 42$; YSC & MO s.n. (TK 15-59, PE).
Poa psilolepis Keng ex L.Liu, $2n = 28$, $2n = 35$, $2n = 28$, 35*, $2n = 28$, 35, 42*; YSC & MO s.n. (TK 15-105, PE).
Poa scabriculum N.R.Cui, $2n = 35$; YSC & MO s.n. (TK 15-150, PE).

IAPT chromosome data 33/11

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All materials CHN.

ASPARAGACEAE

Asparagus officinalis L., $2n = 40$; Russia, Republic of Dagestan, D.A. Krivenko 13484 (IRK, LE, VLA).
Asparagus persicus Baker, $2n = 40$; Russia, Republic of Dagestan, D.A. Krivenko 13475 (IRK, VLA).

ASTERACEAE (COMPOSITAE)

Conyza canadensis (L.) Cronquist (\equiv *Erigeron canadensis* L.), $2n = 18$; Kazakhstan, D.A. Krivenko 13423 (IRK, VLA); Russia, Republic of Dagestan, D.A. Krivenko 13485 (IRK, VLA).

BORAGINACEAE

Heliotropium lasiocarpum Fisch. & C.A.Mey., $2n = 32$; Armenia, D.A. Krivenko & al. 13456 (IRK, VLA).

CAPRIFOLIACEAE

Scabiosa bipinnata K.Koch, $2n = 16$; Georgia, A.A. Markaryan & D.A. Krivenko 13454 (IRK, VLA).

CARYOPHYLLACEAE

Stellaria bungeana Fenzl, $2n = 26$; Russia, Republic of Buryatia, D.A. Krivenko 13425 (IRK, VLA).

EUPHORBIACEAE

Acalypha australis L., $2n = 40$; Russia, Republic of Dagestan, D.A. Krivenko 13453 (IRK, VLA).

LAMIACEAE (LABIATAE)

Ajuga chia Schreb. (\equiv *A. chamaepitys* subsp. *chia* (Schreb.) Arcang.), $2n = 30$; Georgia, D.A. Krivenko & al. 13476 (IRK, VLA).
Scutellaria orientalis L., $2n = 22$; Armenia, D.A. Krivenko & al. 13464 (IRK, VLA).
Sideritis comosa (Rochel ex Benth.) Stankov, $2n = 16$; Georgia, D.A. Krivenko & al. 13448 (IRK, VLA).

NITRARIACEAE

Peganum harmala L., $2n = 24$; Georgia, D.A. Krivenko & al. 13452 (IRK, VLA).

PAPAVERACEAE

Dicentra peregrina (Rudolph) Makino, $2n = 16$; Russia, Kamchatkii Krai, O.A. Chernyagina 13431 (VLA).

PLANTAGINACEAE

Plantago lanceolata L., $2n = 12$; Russia, Republic of Dagestan, D.A. Krivenko 13451 (IRK, VLA).

POACEAE (GRAMINEAE)

Achnatherum sibiricum (L.) Keng ex Tzvelev, $2n = 24$; Russia, Irkutskaya Oblast', O.Yu. Zavgorodnyaya 13432 (VLA).
Anisantha tectorum var. *hirsuta* (Regel) Tzvelev, $2n = 14$; Russia, Kabardino-Balkaria Republic, D.A. Krivenko 13480 (IRK, VLA); Georgia, D.A. Krivenko & al. 13457 (IRK, VLA).
Bromopsis australis (Zherebina) Tzvelev & Prob., $2n = 56$; Russia, Krasnoyarskii Krai, E.B. Volynets 13422 (VLA).
Bromopsis biebersteinii (Roem. & Schult.) Holub (\equiv *Bromus biebersteinii* Roem. & Schult.), $2n = 28$; Georgia, D.A. Krivenko & al. 13462 (IRK, VLA).
Bromopsis gordjagii (Tzvelev) Galushko, $2n = 56$; Russia, Republic of Dagestan, D.A. Krivenko 13486 (IRK, VLA).

Bromus commutatus Schrad., $2n = 14$; Georgia, D.A. Krivenko & al. 13459 (IRK, VLA).

Bromus danthoniae Trin. ex C.A.Mey., $2n = 28$; Armenia, D.A. Krivenko & al. 13468 (IRK, VLA).

Calamagrostis caucasica Trin., $2n = 28$; Russia, Republic of Dagestan, D.A. Krivenko 13488 (IRK, VLA).

Calamagrostis langsdorffii (Link) Trin., $2n = 28$; Russia, Irkutskaya Oblast', O.Yu. Zavgorodnyaya 13443 (VLA), O.Yu. Zavgorodnyaya 13445 (VLA).

Deschampsia biebersteiniana Roem. & Schult., $2n = 26$; Russia, Republic of Dagestan, D.A. Krivenko 13490 (IRK, VLA).

Echinochloa caudata Roshev., $2n = 36$; Russia, Kamchatskii Krai, O.A. Chernyagina & E.A. Devyatova 13264 (VLA), O.A. Chernyagina 13265 (VLA).

Elymus caninus (L.) L., $2n = 28$; Georgia, D.A. Krivenko & al. 13467 (IRK, VLA).

Elymus sibiricus L., $2n = 28$; Russia, Irkutskaya Oblast', O.Yu. Zavgorodnyaya 13442 (VLA).

Hordeum murinum L., $2n = 28$; Armenia, D.A. Krivenko & al. 13478 (IRK, VLA).

Hordeum violaceum Boiss. & Hohen., $2n = 14$; Russia, Republic of Dagestan, D.A. Krivenko 13465 (IRK, VLA).

Poa angustifolia L., $2n = 56$; Russia, Kamchatskii Krai, O.A. Chernyagina 13466 (VLA).

Poa humilis Ehrh. ex Hoffm. (= *P. subcaerulea* Sm.), $2n = 63$; Russia, Kamchatskii Krai, O.A. Chernyagina 13398 (VLA).

Poa nemoralis L., $2n = 28$; Russia, Kabardino-Balkaria Republic, D.A. Krivenko 13489 (IRK, VLA).

Poa sergievskajae Prob., $2n = 56$; Russia, Irkutskaya Oblast', O.Yu. Zavgorodnyaya 13437 (VLA).

Schedonorus pratensis (Huds.) P.Beauv. (= *Lolium pratense* (Huds.) Darbysh.), $2n = 14$; Armenia, D.A. Krivenko & al. 13463 (IRK, VLA).

Setaria viridis (L.) P.Beauv., $2n = 18$; Armenia, D.A. Krivenko & al. 13491 (IRK, VLA); Kazakhstan, D.A. Krivenko 13426 (IRK, VLA); Russia, Republic of Dagestan, D.A. Krivenko 13487 (IRK, PVB, TASH, VLA).

Stipa capillata L., $2n = 44$; Russia, Altaiskii Krai, D.A. Krivenko 13436 (IRK, VLA).

Tragus racemosus (L.) All., $2n = 40$; Georgia, D.A. Krivenko 13461 (IRK, VLA).

Trisetum transcausicum Seredin (≡ *T. buschianum* subsp. *transcausicum* (Seredin) Mosul.), $2n = 28$; Russia, Republic of Dagestan, D.A. Krivenko 13470 (IRK, VLA).

POLYGONACEAE

Rumex chalepensis Mill., $2n = 40$; Armenia, D.A. Krivenko & al. 13450 (IRK, VLA).

Rumex patientia L., $2n = 40$; Russia, Kamchatskii Krai, O.A. Chernyagina 13434 (VLA).

PRIMULACEAE

Androsace filiformis Retz., $2n = 20$; Russia, Kamchatskii Krai, O.A. Chernyagina 13427 (VLA).

RANUNCULACEAE

Anemone sylvestris L. (≡ *Anemonoides sylvestris* (L.) Galasso, Banfi & Soldano), $2n = 16$; Russia, Krasnoyarskii Krai, E.B. Volynets 13429 (VLA).

Pulsatilla nuttalliana (DC.) Spreng., $2n = 16$; Russia, Kamchatskii Krai, O.A. Chernyagina 13430 (VLA).

RESEDAACEAE

Reseda lutea L., $2n = 48$; Georgia, D.A. Krivenko & al. 13455 (IRK, VLA).

RUBIACEAE

Rubia tinctorum L., $2n = 44$; Armenia, D.A. Krivenko & al. 13473 (IRK, LE, TASH, VLA).

SOLANACEAE

Solanum persicum Willd. ex Roem. & Schult., $2n = 24$; Armenia, D.A. Krivenko & al. 13471 (IRK, VLA).

IAPT chromosome data 33/12

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All materials CHN; collectors: *A* = R.D. Almada, *D* = J.R. Daviña, *H* = A.I. Honfi, *Hojs* = D.H. Hojsgaard.

POACEAE

Paspalum aff. *arundinellum* Mez, $2n = 50$; Argentina, Misiones Province, 21 Sep 1992, *H 179* (MNES).

Paspalum falcatum Nees ex Steud., $n = 10$; Argentina, Misiones Province, 16 Feb 2000, *A 74* (CTES, MNES, SI).

Paspalum glaucescens Hack., $2n = 40$; Argentina, Misiones Province, 19 Mar 1991, *H 109* (MNES).

Paspalum indecorum Mez, $n = 10$, Argentina, Misiones Province, 8 Apr 2010, *H 1458* (MNES).

Paspalum jurgensii Hack., $2n = 20$; Argentina, Misiones Province, 19 Feb 1994, *H 597* (MNES).

Paspalum limbatum Henrard, $n = 10$; Argentina, Misiones Province, 22 Sep 2003, *Hojs 295* (MNES).

Paspalum maculosum Trin., $2n = 20$; Argentina, Misiones Province, 25 Nov 2013, *H 1703* (MNES).

Paspalum orbiculatum Poir., $n = 10$, Paraguay, Paraguari Department, 21 Mar 2000, *H & D 1073* (MNES).

Paspalum polyphyllum Nees ex Trin., $n = 20$; Argentina, Misiones Province, 1 Mar 2003, *Hojs 264* (MNES).

Paspalum quarinii Morrone & Zuloaga, $2n = 20$; Argentina, Misiones Province, Caingua Department, Campo Grande, 19 Feb 1994, *H 579* (CTES, MNES).

Paspalum repens P.J.Bergius, $n = 10$; Argentina, Misiones Province, 10 Apr 2003, *Hojs 271* (CTES, MNES, SI).

Paspalum umbrosum Trin., $n = 10$; Paraguay, Itapúa Department, 27 Jan 2003, *D 554* (CTES, MNES).

IAPT chromosome data 33/13

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All materials CHN; vouchers in UB.

POACEAE

Paspalum atratum Swallen, $2n = 40$; Brazil, Distrito Federal, *M.W.S. Sousa 107*.

Paspalum convexum Humb. & Bonpl. ex Flügge, $2n = 32$; Brazil, Distrito Federal, *M.W.S. Sousa 106*, *R.C. Oliveira 3549*; Brazil, Goiás, *M.W.S. Sousa & al. 120*, *M.W.S. Sousa & J.G.F. Silva 110*, *M.W.S. Sousa & J.G.F. Silva 111*, *M.W.S. Sousa & J.G.F. Silva 112*, *R.C. Oliveira 3625*, *R.C. Oliveira 3626*.

Paspalum cordaense Swallen, $2n = 40$, Brazil, Piauí, *M.W.S. Sousa 102*.

Paspalum foveolatum Steud., $2n = 20$, Brazil, Goiás, *M.W.S. Sousa & J.G.F. Silva 113*, *M.W.S. Sousa & J.G.F. Silva 116*; Brazil, Piauí, *M.W.S. Sousa 134*, $2n = 40$, Brazil, Goiás, *M.W.S. Sousa & J.G.F. Silva 114*.

IAPT chromosome data 33/14

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All materials CHN; vouchers in HUNEB.

LEGUMINOSAE

Subfamily Caesalpinioideae sensu lato

Tribe Cassieae

Senna obtusifolia (L.) H.S.Irwin & Barneby, $2n = 26$; Brazil, Bahia, *P.L.B.N. Melo & al. 03*, $2n = 26$, 52; Brazil, Pernambuco, *R.C. Silva & al. 60*.

Senna uniflora (Mill.) H.S.Irwin & Barneby, $2n = 24$; Brazil, Pernambuco, *R.C. Silva & al. 61*.

Tribe Ingeae

Enterolobium timbouva Benth., $2n = 26$; Brazil, Pernambuco, *R.C. Silva & al. 65*.

Mimosoid Clade

Tribe Mimoseae

Anadenanthera colubrina (Vell.) Brenan, $2n = 24$; Brazil, Pernambuco, *R.C. Silva & al. 66*.

Desmanthus pernambucanus (L.) Thell., $2n = 26$; Brazil, Pernambuco, *R.C. Silva & al. 51*.

Mimosa arenosa Poir., $2n = 26$; Brazil, Bahia, *P.C.S.S. Souza & al. 14*; Brazil, Pernambuco, *R.C. Silva & al. 74*.

Mimosa candollei R.Grether, $2n = 52$; Brazil, Pernambuco, *R.C. Silva & al. 76*.

Mimosa ophtalmocentra Mart. ex Benth., $2n = 26$; Brazil, Pernambuco, *R.C. Silva & al. 69*.

Mimosa tenuiflora (Willd.) Poir., $2n = 26$; Brazil, Bahia, *P.C.S.S. Souza & al. 12*; Brazil, Pernambuco, *R.C. Silva & al. 75*.

Piptadenia stipulacea (Benth.) Ducke, $2n = 18$; Brazil, Pernambuco, *R.C. Silva & al. 73*.

IAPT chromosome data 33/15

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All materials CHN; collectors: *A* = Carlos Alberto Acuña, *L* = Graciela Inés Lavia, *P* = Carolina Peichotto, *Pe* = Yanina Pérez, *S* = María Celeste Silvestri, *V* = Ricardo Vanni; vouchers in CTES.

FABACEAE

Stylosanthes guianensis (Aubl.) Sw., $2n = 20$; Argentina, Corrientes, *S, A, L & V SALV3, S, A, L & V SALV4*; Argentina, Misiones, *A & S AS31, A & S AS32*.

Stylosanthes hippocampoides Mohlenbr., $2n = 20$; Argentina, Corrientes, *S, A, L & V SALV1, S, A, L & V SALV5, S, A & P SAP6, A A41, Pe Pe32, Pe Pe34, S, A & L SAL7*.

IAPT chromosome data 33/16

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All materials CHN; collector: *JS* = Jaswant Singh; all materials collected in Uttarkashi District, Uttarakhand, India; vouchers in PUN.

POACEAE

Dactylis glomerata L., $n = 7$; JS 33943, JS 33967, JS 36533, JS 36574, JS 36604, JS 36616, JS 36617, JS 36618. $n = 7 + 0-1B$; JS 33944, JS 33945, JS 36587.
Festuca alata (Hack. ex St.-Yves) Roshev., $n = 14 + 0-1B$; JS 36651.
Festuca gigantea (L.) Vill., $n = 14$; JS 33925, JS 33934, JS 35276, JS 36572, JS 36549, JS 36592, JS 36594, JS 36598, JS 36602, JS 36644.
Festuca rubra L., $n = 28$; JS 36673.
Festuca valesiaca Schleich. ex Gaudin, $n = 14$; JS 33911, JS 33947, JS 36570, JS 36646, JS 36650, JS 36663, JS 36665, JS 36672.

IAPT chromosome data 33/17

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All materials CHN; collectors: GPS = G. Pereira-Silva; JMPC = J.M.P. Cordeiro, MGF = M.G. Facco, TBC = T.B. Cavalcanti.

LYTHRACEAE***Cuphea* P.Browne subg. *Cuphea***

Cuphea circaeoides Sm. ex Sims, $2n = 22$; Brazil, Paraíba, JMPC 1326 (EAN).

Cuphea racemosa (L.f.) Spreng., $n = 8$; Brazil, Rio Grande do Sul, TBC 3879 (CEN).

***Cuphea* subg. *Bracteolatae* S.A.Graham**

Cuphea acinos A.St.-Hil., $n = 8$; Brazil, Minas Gerais, TBC 3904 (CEN).

Cuphea brachiata Mart. ex Koehne, $n = 8$; Brazil, Minas Gerais, TBC 3903 (CEN).

Cuphea calophylla var. *mesostemon* (Koehne) S.A.Graham, $n = 8$; Brazil, Santa Catarina, TBC 3865 (CEN).

Cuphea campestris Mart. ex Koehne, $2n = 16$; Brazil, Paraíba, JMPC 1272 (EAN).

Cuphea confertiflora A.St.-Hil.; $n = 9$; Brazil, Paraná, TBC 3855 (CEN).

Cuphea disperma Koehne, $n = 7$; Brazil, Minas Gerais, TBC 3921 (CEN), TBC 3931 (CEN).

Cuphea ericoides Cham. & Schltdl., $n = 8$; Brazil, Pernambuco, GPS 17190 (CEN), GPS 17191 (CEN). Brazil, Minas Gerais, TBC 3905 (CEN).

Cuphea flava Spreng., $2n = 16$; Brazil, Paraíba, JMPC 1332 (EAN).

Cuphea glutinosa Cham. & Schltdl., $n = 13$; Brazil, Santa Catarina, TBC 3867 (CEN). $n = 16$; Brazil, Paraná, TBC 3854 (CEN).

Cuphea inaequalifolia Koehne, $n = 8$; Brazil, Mato Grosso, GPS 17056 (CEN), GPS 17088 (CEN).

Cuphea laricoides Koehne, $n = 16$; Brazil, Piauí, GPS 17184 (CEN). $n = 24$; Brazil, Piauí, GPS 17180 (CEN).

Cuphea linarioides Cham. & Schltdl., $n = 16$; Brazil, Rio Grande do Sul, TBC 3878 (CEN).

Cuphea linifolia (A.St.-Hil.) Koehne, $n = 9$; Brazil, Rio Grande do Sul, TBC 3880 (CEN). $n = 16$; Brazil, Paraná, TBC 3888 (CEN).

Cuphea loefgrenii Bacig., $n = 8$; Brazil, Piauí, GPS 17183 (CEN), GPS 17188 (CEN). $2n = 16$; Brazil, Piauí, JMPC 1270 (EAN).

Cuphea lutescens Pohl ex Koehne, $n = 7$; Brazil, Minas Gerais, TBC 3898 (CEN); Brazil, Mato Grosso, GPS 17090 (CEN). $n = 8$; Brazil, Minas Gerais, TBC 3910 (CEN).

Cuphea micrantha Kunth, $2n = 16$; Brazil, Paraíba, JMPC 1269 (EAN), JMPC 1325 (EAN).

Cuphea odonellii Lourteig, $n = 8$; Brazil, Mato Grosso, GPS 17050 (CEN).

Cuphea paralarix (Lourteig) T.B.Cavalc. & S.A.Graham, $n = 8$; Brazil, Goiás, TBC 3979 (CEN); Brazil, Minas Gerais, TBC 3910a (CEN).

Cuphea pseudovaccinium A.St.-Hil., $n = 7$; Brazil, Minas Gerais, TBC 3911 (CEN).

Cuphea pulchra var. *corollata* T.B.Cavalc. & S.A.Graham, $n = 24$; Brazil, Bahia, MGF 488 (CEN).

Cuphea pulchra Moric. var. *pulchra*, $n = 16$; Brazil, Bahia, MGF 484 (CEN).

Cuphea rubrovirens T.B.Cavalc., $n = 7$; Brazil, Minas Gerais, TBC 3908 (CEN).

Cuphea sessilifolia Mart., $n = 8$; Brazil, Minas Gerais, TBC 3902 (CEN). $n = 16$; Brazil, Mato Grosso, GPS 17048 (CEN).

Cuphea sperguloides A.St.-Hil., $n = 9$; Brazil, Minas Gerais, TBC 3924 (CEN).

Cuphea spermacoce A.St.-Hil. var. *spermacoce*, $n = 16$; Brazil, Distrito Federal, TBC 3563 (CEN).

Cuphea strigulosa Kunth, $2n = 16$; Brazil, Paraíba, JMPC 1372 (EAN).

Cuphea tuberosa Cham. & Schltdl., $n = 7$; Brazil, Paraná, TBC 3858 (CEN).

Cuphea urbaniana Koehne, $n = 9$; Brazil, Santa Catarina, TBC 3863 (CEN), TBC 3872 (CEN). $n = 16$; Brazil, Santa Catarina, TBC 3868 (CEN). $n = 18$; Brazil, Paraná, TBC 3859 (CEN); Brazil, Santa Catarina, TBC 3870 (CEN).

Pleurophora anomala (A.St.-Hil.) Koehne, $2n = 14$; Brazil, Paraíba, JMPC 1262 (EAN).

IAPT chromosome data 33/18

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All materials CHN.

POACEAE***Paspalum* L. group *Parviflora***




















































































Paspalum clavuliferum C.Wright, $2n = 20$; Brazil, Goiás, R.C. Oliveira & al. 3006 (UB).

Paspalum hyalinum Nees ex Trin., $2n = 40$; Brazil, Mato Grosso, C.O. Moura & Y.F. Figueira-Soares 95 (UB).

Paspalum multicaule Poir., $2n = 20$; Brazil, Amazonas, R.C. Oliveira & al. 3012 (UB), R.C. Oliveira & al. 3014 (UB); Brazil, Goiás, C.O. Moura & Y.F. Figueira-Soares 106 (UB); Brazil, Mato Grosso, C.O. Moura & Y.F. Figueira-Soares 91 (UB); Brazil, Pará, P.L. Viana & R.C. Oliveira 6251 (MG).
Paspalum scalare Trin., $2n = 20$; Brazil, Goiás, C.O. Moura & al. 60 (UB), C.O. Moura & al. 63 (UB)

IAPT CHROMOSOME DATA

IAPT chromosome data 33 – Extended version

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IAPT chromosome data 33/1

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BALSAMINACEAE

Impatiens devendrae Pusalkar

$2n = 14$, CHN. India, Western Himalaya, Uttarakhand, Garhwal, Chamoli, 30°40'47.01"N, 79°35'26.97"E, 2678 m, 6 Aug 2019, shaded or partially shaded, moist forest edges, *Jaya Arora 2551* (DUH 14536) [Table 1].

Impatiens sulcata Wall.

$2n = 20$, CHN. India, Western Himalaya, Uttarakhand, Garhwal, Chamoli, 30°42'42.53"N, 79°35'39.08"E, 3375 m, 5 Aug 2019, moist areas along streams and grassy slopes, *Jaya Arora 2558* (DUH 14538) [Table 1].

GERANIACEAE

Geranium robertianum L.

$2n = 52$, CHN. India, Western Himalaya, Uttarakhand, Garhwal, Chamoli, 30°42'16.70"N, 79°35'32.19"E, 3103 m, 5 Aug 2019, open, landslides, *Jaya Arora 2553* (DUH 14539) [Table 1].

Geranium wallichianum D. Don ex Sweet

$2n = 26$, CHN. India, Western Himalaya, Uttarakhand, Garhwal, Chamoli, 30°42'18.90"N, 79°35'31.87"E, 3138 m, 5 Aug 2019, moist, shaded sites, *Jaya Arora 2555* (DUH 14540) [Table 1].

RANUNCULACEAE

Thalictrum cultratum Wall.

$2n = 14$, CHN. India, Western Himalaya, Uttarakhand, Garhwal, Chamoli, 30°42'18.37"N, 79°35'32.51"E, 3122 m, 5 Aug 2019, moist sites in alpine meadows and shrubberies, *Jaya Arora 2554* (DUH 14541) [Table 1].

Thalictrum elegans Wall. ex Royle

$2n = 14$, CHN. India, Western Himalaya, Uttarakhand, Garhwal, Chamoli, 30°42'46.76"N, 79°35'37.09"E, 3374 m, 5 Aug 2019, rocky slopes, *Jaya Arora 2557* (DUH 14542) [Table 1].

Thalictrum foliolosum DC.

$2n = 14$, CHN. India, Western Himalaya, Uttarakhand, Garhwal, Chamoli, 30°42'18.90"N, 79°35'31.87"E, 3138 m, 5 Aug 2019, forest undergrowth and shrubberies, *Jaya Arora 2556* (DUH 14543) [Table 1].

The Himalaya is one of the global biodiversity hotspots and is known for high plant endemism, and these endemics are disproportionately distributed at elevational ranges between 2800 and 4500 m (Pandit & al., 2014; Manish & al., 2017). While numerous studies

Table 1. Chromosome numbers from the Himalaya counted in the present study and earlier counts found in the online database (<http://legacy.tropicos.org/Project/IPCN>) and in Kumar & Subramaniam (1986).

Species	Family	Elevation range (m)	Chromosome number*	Site characteristics	Previous chromosome counts
<i>Impatiens devendrae</i>	Balsaminaceae	2500–3100	14	Undisturbed	14 (Kumar & Singhal, 2016)
<i>I. sulcata</i>	Balsaminaceae	2000–4000	20	Undisturbed	16, 18, 20 (Jeelani & al., 2010)
<i>Geranium robertianum</i>	Geraniaceae	2500–3600	52	Disturbed	32, 52, 64 (Tofts, 2004)
<i>G. wallichianum</i>	Geraniaceae	1800–3500	26	Undisturbed	26, 28, 56 (Singhal & al., 2017)
<i>Thalictrum cultratum</i>	Ranunculaceae	2500–4200	14	Undisturbed	14 (Bir & al., 1987)
<i>T. elegans</i>	Ranunculaceae	3000–5000	14	Undisturbed	14 (Kaplan & Mulcahy, 1971)
<i>T. foliolosum</i>	Ranunculaceae	2500–3500	14	Undisturbed	14 (Bir & Thakur, 1984)

* Obtained in this study.

have been carried out on the cytogenetic profiles of the Himalayan plant populations, the high-elevation endemic Himalayan plant species are not so well investigated. This is largely due to the inaccessibility and topography of these sites. The investigated species belong to three families and as many genera from an alpine region of the Western Himalaya in India; their geographic locations, elevational ranges and site characteristics are given in Table 1. The goals of the present study were: (i) to determine chromosome numbers of the high-elevation endemic Himalayan species, and (ii) to investigate if the ploidy influences the distribution and conservation status of the species. The information on the chromosome number of plant species is known to be important for ascertaining conservation status (Pandit, 2006; Pandit & al., 2006, 2011; Te Beest & al., 2012).

Young flower buds from 8–10 phenotypes were randomly selected from each natural population in the Garhwal region of Uttarakhand Himalaya from elevations ranging from 1800 to 5000 m (Table 1). The young flower buds were excised from the emerging inflorescences between 6.30 and 11.30 a.m. with a time interval of 15 min and fixed in Carnoy's solution (glacial acetic acid and absolute alcohol, 1 : 3 v/v). These buds were transferred to 70% alcohol after 24 h and stored at 5°C until used. Chromosome numbers were obtained from anther squashes, and the pollen mother cells (PMCs) were stained in 1% propionic carmine. Temporary and permanent smear preparations were observed for cells in various meiotic stages. Between 35 and 50 cells were scored for each species and photographed using a Nikon Optiphot photomicroscope. Direct observations and photo-micrographs were used for recording the meiotic stages. Chromosome counts were made at the diakinesis stage of the PMCs.

Cytological investigations of three families, namely Balsaminaceae (*Impatiens devendrae*, *I. sulcata*), Geraniaceae (*Geranium robertianum*, *G. wallichianum*) and Ranunculaceae (*Thalictrum cultratum*, *T. elegans*, *T. foliolosum*), are reported here. The chromosome counts of the investigated species revealed that these were diploid, except for *Geranium robertianum*, which had a tetraploid chromosome count ($2n = 52$), while its congener *G. wallichianum* showed a diploid chromosome count ($2n = 26$). Earlier chromosome number reports of all the investigated species were confirmed (Table 1). Notably, the diploid species were largely restricted to undisturbed, natural sites inside forests or to alpine meadows and had lower population numbers, while the lone polyploid species was extensively distributed in highly disturbed sites, mostly by landslides, with a higher number of individuals. This was confirmed in the present study. Other regional and global-scale studies have

shown that polyploids are better colonizers, invaders and have the competitive ability for range expansion in nutrient-poor habitats (Pandit, 2006; Funk & Vitousek, 2007; Pandit & al., 2011; Te Beest & al., 2012).

Studies in *Centaurea stoebe* and other plant taxa have shown that diploid and tetraploid cytotypes were spatially segregated in south-western Slovakia and north-eastern Austria. Tetraploids showed preferential colonization of drier and open locations in a habitat with human-induced disturbance, but were absent from sites with denser vegetation (Mráz & al., 2012). Our findings, though limited in extent, point to similar conclusions; the polyploid *Geranium robertianum* inhabited disturbed habitats and open locations compared to *G. wallichianum*, which inhabited forests and sites with thicker vegetation cover. Our studies also support earlier findings that polyploids are selected in extreme and unstable environmental conditions such as high elevations with extreme weather conditions and short growth cycles (Knight & al., 2005; Qiu & al., 2019).

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IAPT chromosome data 33/2

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Methods for chromosome analysis according to Cordeiro & al. (2017a).

- * New cytotype for the species.
- ** First chromosome count for the genus.
- # First chromosome count for the species.

ACANTHACEAE

Subfamily Acanthoideae

Tribe Justiceae

* *Dicliptera mucronifolia* Nees

$2n = 80$, CHN. Brazil, Paraíba, Serra da Raiz, 06°43'57"S, 35°27'25"W, 25 Nov 2015, *J.M.P. Cordeiro 1020* (EAN) [Fig. 2C].

** *Harpochilus neesianus* Mart. ex Nees

$2n = 28$, CHN. Brazil, Paraíba, Casserengue, 06°45'31"S, 35°53'44"W, 17 Oct 2018, *J.M.P. Cordeiro 1399* (EAN) [Figs. 1C, 2D].

Justicia aequilabris (Nees) Lindau

$2n = 28$, CHN. Brazil, Paraíba, Maturéia, 07°15'54"S, 37°22'33"W, 14 May 2016, *L.P. Felix 15922* (EAN) [Figs. 1D, 2E].

Justicia birae A.S.Reis, F.A.Silva, A.Gil & Kameyama

$2n = 28$, CHN. Brazil, Pará, São Felix do Xingu, 06°38'29"S, 51°58'44"W, 17 Sep 2016, *L.P. Felix 15982* (EAN) [Figs. 1E, 2F].

Justicia chamaedryoides (Nees) Wassh. ex A.L.A.Côrtes & P.L.R.Moraes

$2n = 18$, CHN. Brazil, Paraíba, Pilões, 06°42'00"S, 35°36'54"W, 14 Feb 2016, *J.M.P. Cordeiro 1041* (EAN) [Fig. 2G].

Tribe Ruellieae

Hygrophila paraibana Rizzini

$2n = 60$, CHN. Brazil, Pernambuco, Pesqueira, 06°20'08"S, 36°42'54"W, 25 Aug 2016, *L.P. Felix 15979* (EAN) [Fig. 2H].

Ruellia asperula (Mart. & Nees) Lindau

$2n = 34$, CHN. Brazil, Paraíba, Maturéia, 07°15'54"S, 37°22'33"W, 14 May 2016, *L.P. Felix 15923* (EAN) [Figs. 1F, 2I].

Ruellia bahiensis Morong

$2n = 34$, CHN. Brazil, Paraíba, Sertãozinho, 06°44'06"S, 35°27'30"W, 2 Jan 2020, *J.M.P. Cordeiro 1476* (EAN) [Fig. 3A].

Ruellia cearensis Lindau

$2n = 34$, CHN. Brazil, Pernambuco, Taquaritinga do Norte, 07°54'28"S, 36°01'19"W, 17 Sep 2016, *L.P. Felix 15995* (EAN) [Figs. 1G, 3B].

Ruellia geminiflora Kunth

$2n = 34$, CHN. Brazil, Pernambuco, Taquaritinga do Norte, 07°54'33"S, 36°01'37"W, 17 Sep 2016, *L.P. Felix 15990* (EAN) [Fig. 3C].

Ruellia inundata Kunth

$2n = 34$, CHN. Brazil, Paraíba, Serra da Raiz, 06°43'57"S, 35°27'25"W, 2 Jan 2020, *J.M.P. Cordeiro 1477* (EAN) [Fig. 3D].

Ruellia ochroleuca Mart. ex Nees

$2n = 34$, CHN. Brazil, Paraíba, Areia, 06°57'49"S, 35°45'00"W, 15 Nov 2017, *J.M.P. Cordeiro 1199* (EAN) [Fig. 1H, 3E].

Ruellia paniculata Kunth

$2n = 34$, CHN. Brazil, Pernambuco, Pesqueira, 06°20'08"S, 36°42'54"W, 25 Aug 2016, *L.P. Felix 15978* (EAN) [Figs. 1I, 3F].

Ruellia simplex C.Wright

$2n = 34$, CHN. Brazil, Paraíba, Areia, 06°58'12"S, 35°42'46"W,
7 Jan 2020, J.M.P. Cordeiro 1478 (EAN) [Fig. 3G].

Subfamily Nelsonioideae

Elytraria imbricata (Vahl) Pers.

$2n = 24$, CHN. Brazil, Paraíba, Areia, 06°53'19"S, 35°43'43"W,
29 Jun 2016, J.M.P. Cordeiro 1052 (EAN) [Figs. 1A, 2A].

Nelsonia canescens (Lam.) Spreng.

$2n = 72$, CHN. Brazil, Paraíba, Sertãozinho, 06°44'06"S, 35°27'
30"W, 2 Jan 2020, J.M.P. Cordeiro 1474 (EAN) [Figs. 1B, 2B].

The family Acanthaceae comprises approximately 210 genera and 4000 species with pantropical distributions (McDade & al., 2008; Daniel & McDade, 2014; Christenhusz & Byng, 2016). The family is monophyletic and divided into four subfamilies: Acanthoideae, Avicennioideae, Nelsonioideae, and Thunbergioideae (McDade & al., 2008). Acanthaceae species demonstrate wide morphological variability (Fig. 1), different biogeographic patterns, and occupy varied habitats (Scotland & Vollesen, 2000; McDade & al., 2008), so that new combinations, taxonomic revisions, and new species descriptions still frequently appear (Daniel & McDade, 2014; Monteiro & al., 2018; Costa-Lima & Chagas, 2019; Silva & al., 2019).

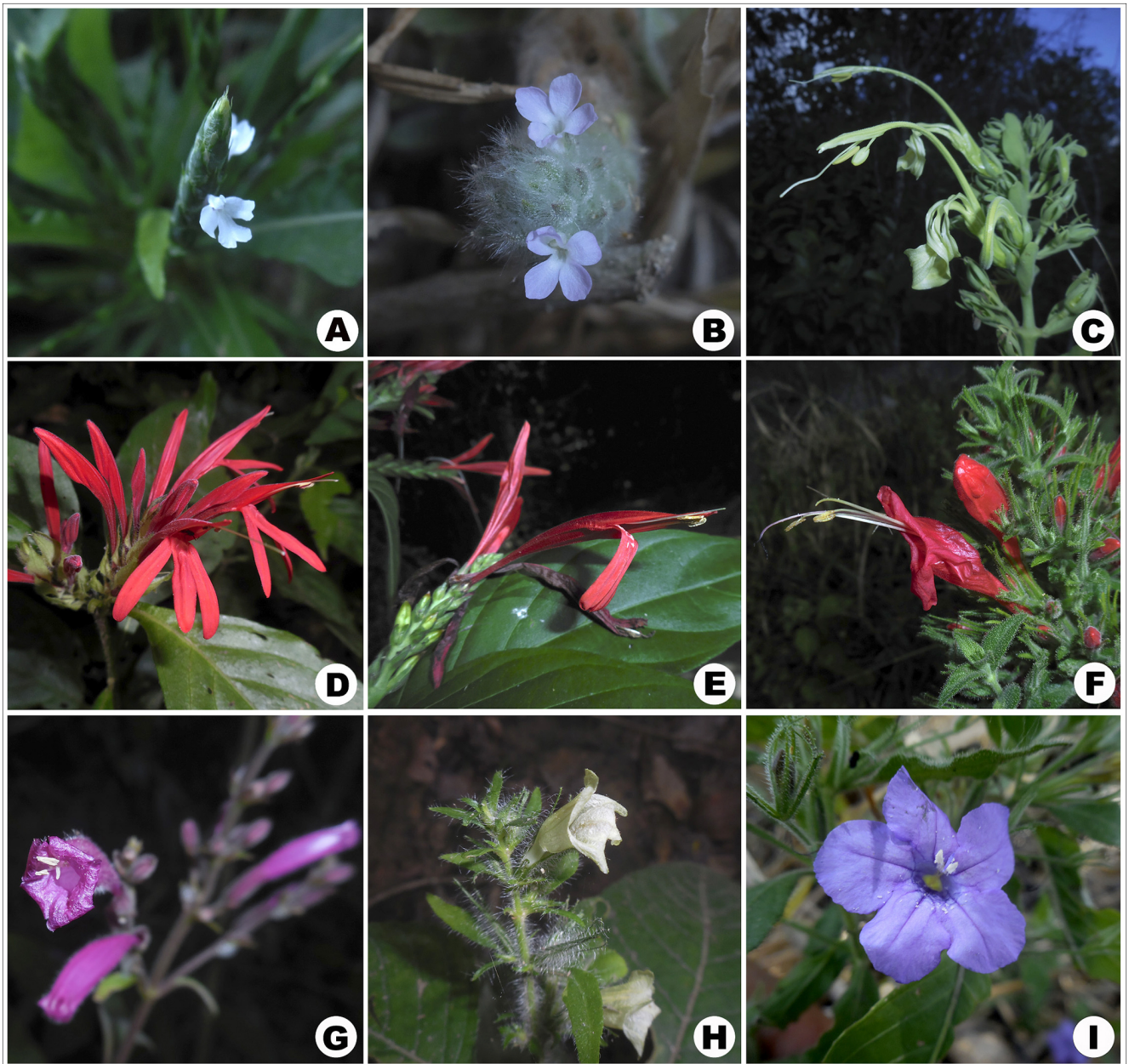


Fig. 1. Representative species of the Acanthaceae. **A & B**, Nelsonioideae: **A**, *Elytraria imbricata*; **B**, *Nelsonia canescens*. **C–E**, Acanthoideae (Justicieae): **C**, *Harpochilus neesianus*; **D**, *Justicia aequilabris*; **E**, *Justicia birae*. **F–I**, Acanthoideae (Ruellieae): **F**, *Ruellia asperula*; **G**, *Ruellia cearensis*; **H**, *Ruellia ochroleuca*; **I**, *Ruellia paniculata*. — Photos: Joel M.P. Cordeiro.

Cytogenetic analyses of Acanthaceae have demonstrated wide variations of their chromosome records from $2n = 18$ in most species of Thunbergioideae to $2n = \text{ca. } 132$ and 136 in *Sanchezia nobilis* Hook.f. (Grant, 1955; Rice & al., 2015). Some groups do, however, demonstrate notably constant chromosome numbers such as $2n = 34$ in *Ruellia* L. (Grant, 1955; Piovano & Bernardello, 1991), $2n = 40$ in *Barleria* L. (Joshi & al., 2016), $2n = 28$ in *Justicia* L. (Grant, 1955; Rice & al., 2015), and $2n = 18$ in *Thunbergia* Retz. (Grant, 1955). We present here new chromosome records for the genus *Harpochilus* Nees (*Harpochilus neesianus*, $2n = 28$) and the species *Justicia aequilabris* and *J. birae* (both with $2n = 28$), in addition to

Ruellia cearensis, *R. ochroleuca*, and *R. paniculata* with $2n = 34$. A new cytotype is described for *Dicliptera mucronifolia* ($2n = 80$), which differs from the only previous record for the species of $2n = 60$ (Cordeiro & al., 2017b).

Chromosome numbers derived from $x = 14$ and $x = 21$ are frequent in Acanthaceae, suggesting $x = 7$ as the most probable basic ancestral number for the family (Grant, 1955; Raven, 1975). Nonetheless, few chromosomal records are available for the basal subfamily Nelsonioideae, which demonstrates ample numerical variations, as can be seen with *Elytraria* Michx. ($2n = 22, 24, 34, 44, 46$ and 50) and *Nelsonia canescens* ($2n = 28, 32, 34$ and 72)

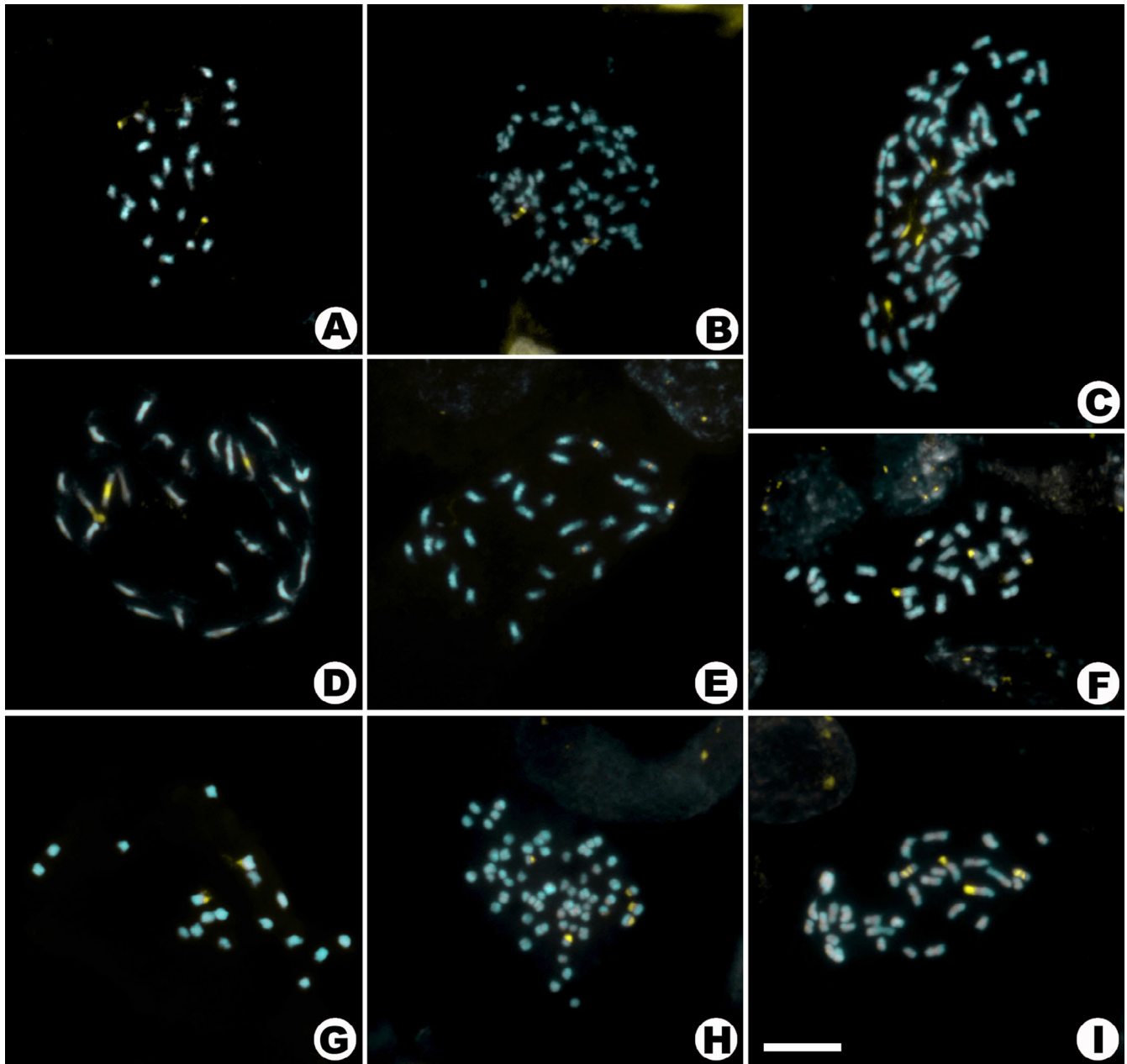


Fig. 2. A & B, Nelsonioideae: A, *Elytraria imbricata*, $2n = 24$; B, *Nelsonia canescens*, $2n = 72$. C–G, Acanthoideae (Justicieae): C, *Dicliptera mucronifolia*, $2n = 80$; D, *Harpochilus neesianus*, $2n = 28$; E, *Justicia aequilabris*, $2n = 28$; F, *Justicia birae*, $2n = 28$; G, *Justicia chamaedryoides*, $2n = 18$; H & I, Acanthoideae (Ruellieae). H, *Hygrophila paraibana*, $2n = 60$; I, *Ruellia asperula*, $2n = 34$. — Scale bar = 10 μm .

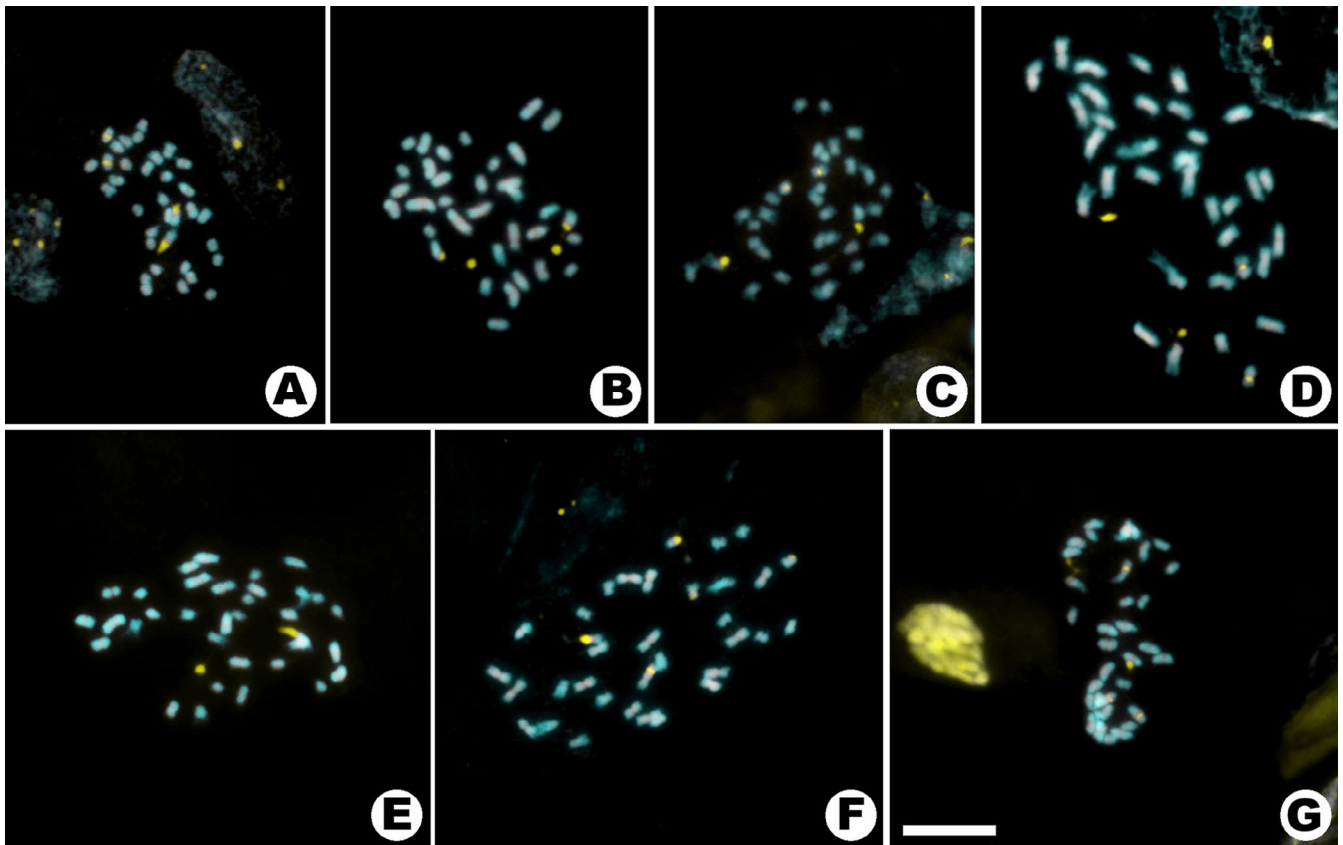


Fig. 3. Acanthoideae (Ruellieae): **A**, *Ruellia bahiensis*, $2n = 34$; **B**, *Ruellia cearensis*, $2n = 34$; **C**, *Ruellia geminiflora*, $2n = 34$; **D**, *Ruellia inundata*, $2n = 34$; **E**, *Ruellia ochroleuca*, $2n = 34$; **F**, *Ruellia paniculata*, $2n = 34$; **G**, *Ruellia simplex*, $2n = 34$. — Scale bar = 10 μm .

(Daniel & McDade, 2014; Rice & al., 2015). As such, disploidy and polyploidy events that have occurred along the evolutionary histories of diverse groups of Acanthaceae have made determination of the ancestral basic number of that family uncertain.

Here, we used the fluorochromes chromomycin A3 (CMA) and 4',6-diamidino-2-phenylindole (DAPI) to demonstrate the occurrence of heterochromatic regions in Acanthaceae. Karyotypes of the species revealed the occurrence of GC-rich heterochromatin (CMA^+) distributed in terminal, proximal, and interstitial regions of the chromosomes (Figs. 2, 3). Variations in CMA/DAPI banding patterns have become important cytotaxonomic tools and have contributed to descriptions of new species (Pessoa & al., 2014; Almeida & al., 2016), revealed ecological and biogeographic patterns (VanLume & al., 2017), and aided in the karyological differentiation of taxa with numerically and morphologically stable chromosomes (Barros e Silva & al., 2010; Cordeiro & al., 2017a, 2020).

The patterns of CMA/DAPI bands in some plant groups have often been found to be correlated with different tribes, clades, and taxonomic groups (Chiarini & al., 2013; Acosta & al., 2016; Cordeiro & al., 2020). The species of Acanthaceae analyzed up to the present time (Cordeiro & al., 2017a; present work) show, however, what appears to be rather random distributions of CMA^+ heterochromatin among the different subfamilies, tribes, and genera. The most common pattern, forming two terminal CMA^+ bands, was observed in *Elytraria imbricata* and *Nelsonia canescens* (Nelsonioideae), *Justicia chamaedryoides* (Acanthoideae, Justicieae) as well as in *Ruellia cearensis* and *R. ochroleuca* (Acanthoideae, Ruellieae). That pattern seems to be the most frequent among angiosperms in general

and corresponds to the heterochromatin formed by NORs (nucleolus organizing regions) (Guerra, 2000; Roa & Guerra, 2012; Cordeiro & al., 2017b).

The distribution of CMA/DAPI bands, on the other hand, appeared to be useful for cytotaxonomically differentiating stable groups of Acanthaceae. All of the *Ruellia* species examined, for example, demonstrated $2n = 34$, but the distributions of their heterochromatic bands were quite variable, even among closely related species such as *R. asperula*, *R. inundata*, and *R. paniculata*. Likewise, *Justicia aequilabris* and *J. birae* (morphologically similar species; Fig. 1D,E), both $2n = 28$, demonstrated four proximal CMA^+ bands (Fig. 2E) and three terminal and one proximal CMA^+ band (Fig. 2F), respectively. Therefore, although heterochromatin distribution does not apparently follow a clear pattern among the subfamilies and tribes of Acanthaceae, the variability of CMA/DAPI band distributions can offer cytotaxonomically informative data related to numerically stable genera, such as *Ruellia* and *Justicia*.

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IAPT chromosome data 33/3

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* First chromosome count for a given taxon.

▼ First chromosome count for an accession of the species from the referenced country.

OROBANCHACEAE

▼ *Melampyrum arvense* L.

2n = 18, CHN. Austria, Mödling, Eichkogel, 33UWP9524, 250 m, 13 Jul 2000, D. Albach, L. Delgado 545, M.M. Martínez-Ortega, J.A. Sánchez-Agudo & E. Rico (SALA 118392); Austria, Niederösterreich (St. Pölten), Mödling, Eichkogel, 33UWP9624, 340 m, 21 Jul 2005, L. Delgado 947, M.M. Martínez-Ortega, L.M. Muñoz-Centeno & M. Santos-Vicente (SALA 134801); Romania, Cojocna, 34TGS1681, 385 m, 1 Jul 2000, X. Giraldez 75, M.M. Martínez-Ortega & J.A. Sánchez-Agudo (SALA 102559) [Fig. 4A].

The chromosome number found (2n = 18) agrees with previously published data (cf. Bolkhovskikh & al., 1969; Moore, 1977; Goldblatt & Johnson, 1979+). This is the first chromosome count conducted on this species from Romania.

▼ *Melampyrum barbatum* Waldst. & Kit. ex Willd.

n = 9, 2n = 18, CHN. Romania, Cojocna (Cojocna), 30 km from Cluj-Napoca, 385 m, 1 Jul 2000, X. Giraldez 76, M.M. Martínez-Ortega & J.A. Sánchez-Agudo (SALA 102560) [Fig. 4B,C].

2n = 18, CHN. Austria, Mödling, Eichkogel, 33UWP9524, 250 m, 13 Jul 2000, D. Albach, L. Delgado 528, M.M. Martínez-Ortega, J.A. Sánchez-Agudo & E. Rico (SALA 118377) [Fig. 4D].

The number obtained in the present study agrees with the only count carried out for this species by Greilhuber (1973) in Austria. The haploid number was counted from several metaphases of the first pollen grain mitosis (Fig. 4B). This is the first record of the chromosome number for this species from Romania.

* *Melampyrum italicum* Soó

$2n = 18$, CHN. Italy, Abruzzo, Teramo, Ceppo, Mount Laga, forest of Morricana, 33TUH7124, 1395 m, 3 Jul 2002, *A. Herrero 1927 & al.* (SALA 134806) [Fig. 4E].

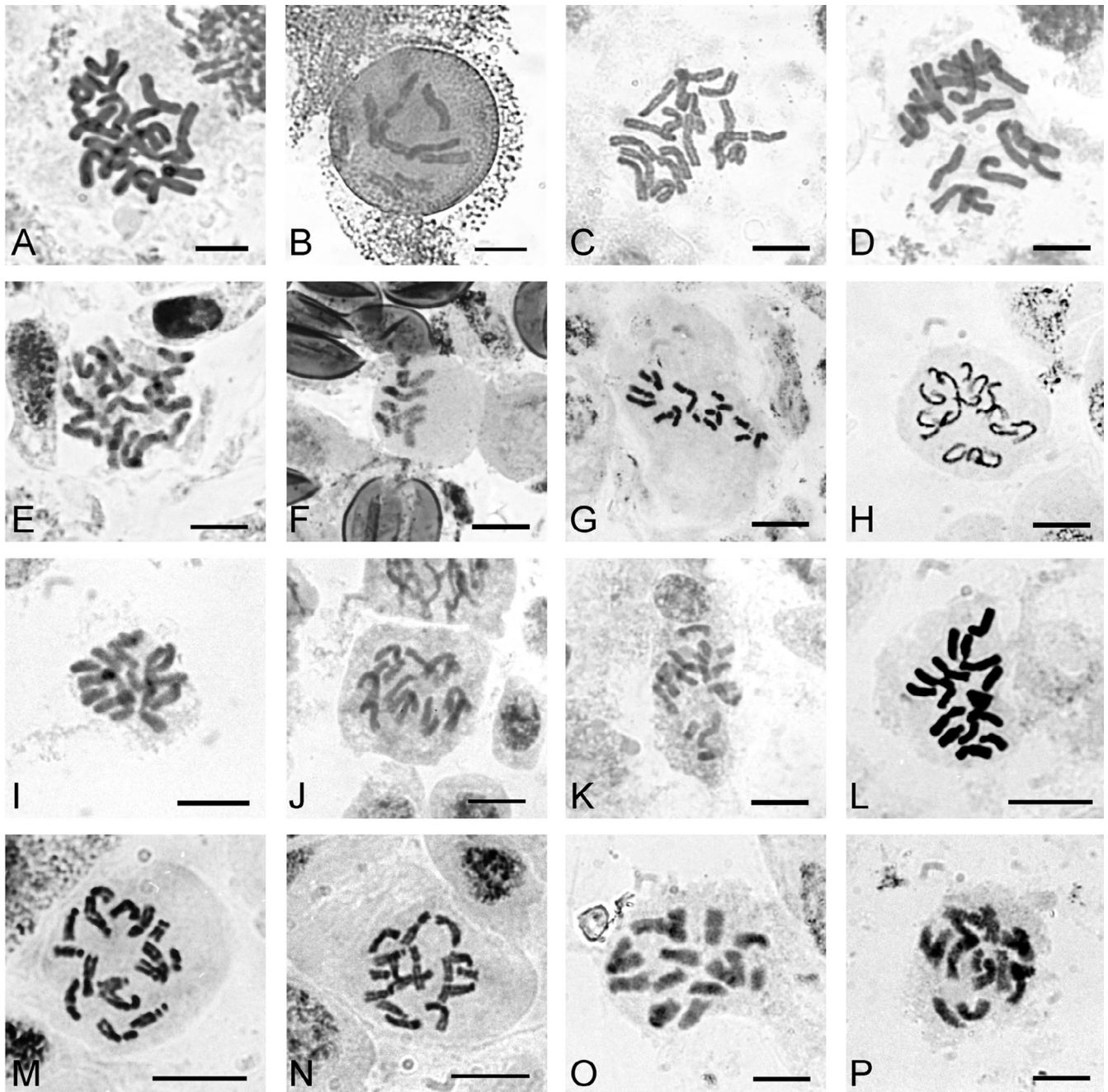


Fig. 4. A, *Melampyrum arvense*, mitotic metaphase, $2n = 18$ (SALA 102559). B–D, *M. barbatum*: B, Mitotic metaphase in pollen grain, $n = 9$ (SALA 102560); C, Mitotic metaphase, $2n = 18$ (SALA 102560); D, Mitotic metaphase, $2n = 18$ (SALA 118377). E, *M. italicum*, mitotic metaphase, $2n = 18$ (SALA 134806). F & G, *Pedicularis acmodonta*: F, Mitotic metaphase in pollen grain, $n = 8$ (SALA 134804); G, Mitotic metaphase, $2n = 16$ (SALA 134808). H–P, Mitotic metaphases, $2n = 16$; H, *P. aspleniifolia* (SALA 123300); I, *P. atropurpurea* (SALA 120596); J & K, *P. cenisia* (SALA 118007); L, *P. comosa* subsp. *asparagoides* (SALA 110784); M & N, *P. comosa* subsp. *comosa* (SALA 110782); O & P, *P. condensata* (SALA 134813). — Scale bars = 10 μm .

Melampyrum pratense L.

$2n = 18$, CHN. Austria, Steiermark, Gröbming, ascent to Stoderzinken (at the end of the road), 33TVN15, 2040 m, 15 Jul 2000, *D. Albach, L. Delgado, M.M. Martínez-Ortega, J.A. Sánchez-Agudo & E. Rico* 7534 (SALA 118113).

▼ *Melampyrum sylvaticum* L.

$2n = 18$, CHN. Austria, Steiermark, Weyern quarry towards Gröbming, 33TVN15, 886 m, 14 Jul 2000, *D. Albach, L. Delgado, M.M. Martínez-Ortega, J.A. Sánchez-Agudo* 116 & *E. Rico* (SALA 118166); France, Department of Savoie, Lanslebourg, ascent to Mont Cenis pass, 32TLR3316, 1800 m, 8 Jul 2000, *L. Delgado, M.M. Martínez-Ortega* 912, *J.A. Sánchez-Agudo & E. Rico* (SALA 117978).

The chromosomal number of this species is known from populations distributed throughout northern and central Europe (cf. Bolkhovskikh & al., 1969; Moore, 1973; Goldblatt & Johnson, 1979+; Rice & al., 2015). This is the first chromosome count for an accession of *M. sylvaticum* from France.

* *Melampyrum vaudense* (Ronniger) Soó

$2n = 18$, CHN. France, Department of Alpes-de-Haute-Provence, Gleizolles, 32TLQ2227, 1310 m, 24 Jul 2005, *L. Delgado* 948, *M.M. Martínez-Ortega, L.M. Muñoz-Centeno & M. Santos-Vicente* (SALA 134802).

* *Pedicularis acmodonta* Boiss.

$n = 8$, $2n = 16$, CHN. Armenia, Gegharkunik, Vardenis Mts., ca. 4 km before Selim pass, 38TMK2031, 2260 m, 23 Jun 2005, *A. Herrero* 2582 & al. (SALA 134804) [Fig. 4F]; Armenia, Aragatsotn, Aragats mountain, Ghazaravan, on the descent from lake Kari, 38TMK3082, 3190 m, 30 Jun 2005, *L. Medina* 2521 & al. (SALA 134812).

$2n = 16$, CHN. Armenia, Gegharkunik, close to Sevan lake, 38TMK9693, 1950 m, 19 Jun 2005, *C. Aedo* 11590 & al. (SALA 134808) [Fig. 4G]; Turkey, Gümüşhane, Güvercinlik, 37TEE7068, 2000 m, 26 Jun 2001, *S. Nisa* 708 & al. (SALA 120484).

Pedicularis aspleniifolia Flörke ex Willd.

$2n = 16$, CHN. Austria, Salzburg, Hohe Tauern, Glockner-Gruppe: Fusch an der Glocknerstraße; between the northern portal of Hochtor-Tunnel and Tauernkogel, 33TUN3617, 2550 m, 1 Aug 2007, *A. Tribsch* 4560 & al. (SALA 123300) [Fig. 4H].

The reported chromosome number for this species endemic to the Alps agrees with the single count published to date (Mattick-Ehrensberger, 1950), also performed using individuals collected in Austria.

* *Pedicularis atropurpurea* Nordm.

$2n = 16$, CHN. Turkey, İkizdere, 8 km before Porto Ovit Dagi Geçidi, northern slope, 37TFF40, 2070 m, 29 Jun 2001, *S. Nisa* 896 & al. (SALA 120596) [Fig. 4I].

* *Pedicularis cenisia* Gaudin

$2n = 16$, CHN. France, Department of Savoie, Mont Cenis pass, 32TLR3214, 2400 m, 8 Jul 2000, *L. Delgado, M.M. Martínez-Ortega* 941, *J.A. Sánchez-Agudo & E. Rico* (SALA 118007) [Fig. 4J,K].

Pedicularis comosa subsp. *asparagoides* (Lapeyr.) P.Fourn.

$2n = 16$, CHN. France, Department of Pyrénées-Orientales, Puig Neulós, 31TDH00, 1200 m, Jun 2000, *M. Galbany & al.* IG 1 (SALA 110784) [Fig. 4L].

The chromosomal number counted in this species endemic to the Pyrenees agrees with the previously published one by Küpfer (1974, as “*P. asparagoides*”).

▼ *Pedicularis comosa* L. subsp. *comosa*

$2n = 16$, CHN. Italy, Abruzzo, L’Aquila, Campo Imperatore, 33TUH8000, 2175 m, 30 Jun 2002, *C. Aedo* 8317 & al. (MA 699688); Spain, León, San Emiliano, Ventana pass, Peñón de Ventana, 30TTN5571, 1700 m, 27 Jun 1999, *L. Delgado* 231 & *M.M. Martínez-Ortega* (SALA 110782) [Fig. 4M,N]; Spain, Lérida, Alto Arán, Pla de Beret, 31TCH3234, 2200 m, 28 Jun 2000, *L. Delgado* 346 & *I. Soriano* (SALA 110783).

Our data match the previous counts carried out in populations from the Pyrenees (Küpfer, 1974) and central Europe (Murin & Májovský, 1976). This is the first chromosome count from an Italian accession.

* *Pedicularis condensata* M.Bieb.

$2n = 16$, CHN. Armenia, Gegharkunik, close to Sevan lake, 38TMK9693, 2400 m, 19 Jul 2005, *C. Aedo* 11739 & al. (SALA 134811); Armenia, Kotayk, close to Tsahkadzor village, Tehenis mountain, 38TMK7387, 2250 m, 22 Jun 2005, *S. Castroviejo & al.* 17702 (SALA 134813) [Fig. 4O,P].

* *Pedicularis elegans* subsp. *praetutiana* (Levier ex Steininger) Pign. Wik.

$2n = 16$, CHN. Italy, Abruzzo, L’Aquila, Campo Imperatore, 33TUH8000, 2175 m, 30 Jun 2002, *C. Aedo* 8308 & al. (SALA 134810) [Fig. 5A].

Pedicularis elongata A.Kern.

$2n = 16$, CHN. Italy, Venice, Misurina, Tre Cime di Lavaredo, 33TTM9265, 2450 m, 18 Jul 2000, *L. Delgado, M.M. Martínez-Ortega, J.A. Sánchez-Agudo & E. Rico* 7642 (SALA 118546); Italy, Venice, Cortina D’Ampezzo, Passo Tre Croci, 33TTM8559, 1600 m, 18 Jul 2000, *L. Delgado, M.M. Martínez-Ortega, J.A. Sánchez-Agudo & E. Rico* 7668 (SALA 118573).

The reported chromosome number ($2n = 16$) for this species endemic to the SE Alps agrees with previous counts performed in Austrian (cf. Dobeš & Vitek, 2000) and Italian populations ($n = 8$; Favarger & Huynh, 1964; Favarger, 1965).

Pedicularis foliosa L.

$n = 8$, $2n = 16$, CHN. Spain, Huesca, Ansó, screes near to Estanés lake, 30TXN9641, 1800 m, 23 Jul 1998, *S. Bernardos, L. Delgado* 76 & *J.A. Sánchez-Agudo* (SALA 110814) [Fig. 5B,C].

$2n = 16$, CHN. Spain, Lérida, Vielha, Ribagorçana River, near the entrance to the Vielha tunnel, 31TCH1621, 1600 m, 27 Jun 2000, *L. Delgado* 341 & *I. Soriano* (SALA 110813).

The haploid chromosome number ($n = 8$) has been counted from mitotic metaphase in pollen grains (Fig. 5B), and it coincides with that reported by Witsch (1932). The diploid number ($2n = 16$) agrees with that reported for central Europe (Mattick-Ehrensberger, 1950; Delay, 1974) and for the Iberian Peninsula (Küpfer, 1974).

* *Pedicularis graeca* Bunge

$2n = 16$, CHN. Greece, Epirus, Ioannina, Peristeri mountain, Tsoukarela Peak, 34SEJ1092, 2290 m, 30 Jun 2007, *S. Castroviejo* 18338 & al. (SALA 134814) [Fig. 5D].

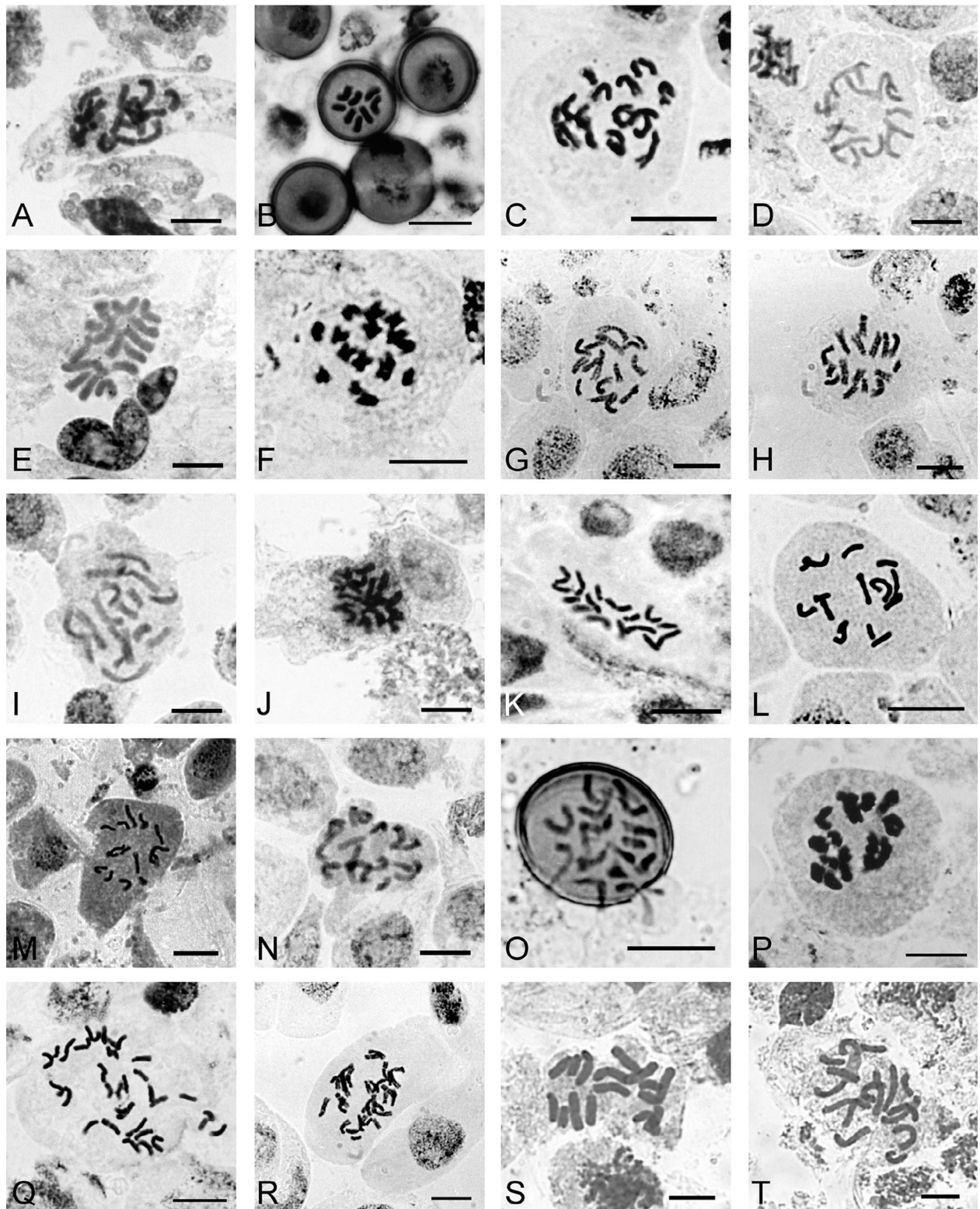


Fig. 5. A, *Pedicularis elegans* subsp. *praetutiana*, mitotic metaphase, $2n = 16$ (SALA 134810). B & C, *P. foliosa*: B, Mitotic metaphase in pollen grain, $n = 8$ (SALA 110814); C, Mitotic metaphase, $2n = 16$ (SALA 110814). D, *P. graeca*, mitotic metaphase, $2n = 16$ (SALA 134814). E, *P. hoermanniana*, mitotic metaphase, $2n = 16$ (SALA 134807). F, *P. kernerii*, early meiotic anaphase I in megaspore mother cell, $n = 8$ (SALA 110799). G–N, Mitotic metaphases, $2n = 16$: G & H, *P. mixta* (SALA, 110808); I, *P. orthantha* (SALA 134816); J, *P. pontica* (SALA 120572); K, *P. pyrenaica* var. *fallax* (SALA 110806); L, *P. pyrenaica* (SALA 110800); M, *P. rosea* subsp. *allionii* (SALA 110815); N, *P. rostratocapitata* (SALA 118456). O–R, *P. schizocalyx*: O, Mitotic metaphase in pollen grain, $n = 16$ (SALA 110787); P, Meiotic metaphase I in pollen mother cell, $n = 16$ (SALA 110790); Q & R, Mitotic metaphases, $2n = 32$ (SALA 110790, SALA 110788); S & T, *P. sibthorpii*, mitotic metaphase, $2n = 16$ (SALA 119845). — Scale bars = 10 μm .

* *Pedicularis hoermanniana* K.Malý

$2n = 16$, CHN. Bulgaria, Kyustendil, Rila Mountains, Suhoto lake, 34TGM0071, 1885 m, 7 Jul 2004, *C. Aedo 10417 & al.* (SALA 134807) [Fig. 5E].

▼ *Pedicularis kernerii* Dalla Torre

$n = 8$, $2n = 16$, CHN. Spain, Lérida, Alto Arán, Arán Valley, Pla de Beret, Noguera River, 31TCH3135, 2350 m, 28 Jun 2000, *L. Delgado 348 & I. Soriano* (SALA 110799) [Fig. 5F].

The number $2n = 16$ has been confirmed here for the first time in Iberian material and matches previous counts conducted in plants from the Alps (Favarger, 1959, 1969). Our data confirm the diploid level of this Alpine-Pyrenean endemic throughout its range. The haploid level ($n = 8$) has been counted in early meiotic anaphase I in megaspore mother cells (Fig. 5F). This is the first chromosome count conducted from a Spanish accession.

* *Pedicularis mixta* Gren.

$n = 8$, $2n = 16$, CHN. Spain, Huesca, Benasque, Cerler, ski station, 31TCH0014, 1950 m, 1 Aug 1999, *L. Delgado 280 & M.M. Martínez-Ortega* (SALA 110810); Spain, Huesca, Benasque, Cerler, ski station, 31TCH0014, 1950 m, 1 Aug 1999, *L. Delgado 282 & M.M. Martínez-Ortega* (SALA 110811).

$2n = 16$, CHN. Spain, León, Boca de Huérgano, Valle Estébano stream, 30TUN5569, 1600 m, 7 Jun 2001, *L. Delgado 777 & E. Rico* (SALA 110808) [Fig. 5G,H]; Spain, Lérida, Vielha, Ribagorçana River, 31TCH1621, 1600 m, 27 Jun 2000, *L. Delgado 343 & I. Soriano* (SALA 110809); Spain, Lérida, Vielha, Pleta de Molieres, next to the S portal of the Vielha tunnel, 31TCH1522, 1625 m, 20 Jul 1998, *I. Soriano 98127 & M. Galbany* (BCN 10514); Spain, Zamora, Porto, Peña Trevinca, 29TPG87, 27 Jul 2002, *P. Bariego & E. Rico* (SALA 110807).

Pedicularis nordmanniana Bunge

$2n = 16$, CHN. Turkey, İkizdere, Porto Ovit Dagı Geçidi, 37TFE49, 2640 m, 28 Jun 2001, *S. Nisa 792 & al.* (SALA 120528).

This chromosomal count was carried out in a population from the Pontic Alps, and the number found agrees with previously published data (cf. Moore, 1973).

Pedicularis orthantha Griseb.

$2n = 16$, CHN. Bulgaria, Sofia, Vitoshka Mountain, 34TFN8915, 1891 m, 8 Jul 2004, *M.L. Alarcón 207 & al.* (SALA 134817); Bulgaria, Sofia, Samokov, Rila Mountains, Markoudjika, Musala Mountain, 34TGM1375, 2358 m, 9 Jul 2004, *M.L. Alarcón 279 & al.* (SALA 134816) [Fig. 5I].

The chromosome number ($2n = 16$) found in the populations studied of this endemic species of the Balkan Peninsula agrees with the data published in the literature (cf. Goldblatt & Johnson, 1979+)

* *Pedicularis pontica* Boiss.

$2n = 16$, CHN. Turkey, İkizdere, Porto Ovit Dagı Geçidi, 37TFE49, 2640 m, 28 Jun 2001, *S. Nisa 860 & al.* (SALA 120572) [Fig. 5J].

* *Pedicularis pyrenaica* var. *fallax* Font Quer & Guinea

$2n = 16$, CHN. Spain, Cantabria, Fuente Dé, north ascent to Cueto Redondo, 30TUN5479, 1740 m, 5 Aug 2001, *L. Delgado 797* (SALA 110806) [Fig. 5K].

This variety of *P. pyrenaica* J.Gay subsp. *pyrenaica* is located in the Cantabrian Mountains (North of the Iberian Peninsula; Soriano, 2009). Our count is the first carried out in this taxon.

Pedicularis pyrenaica J.Gay subsp. *pyrenaica*

$2n = 16$, CHN. Spain, Huesca, Benasque, Cerler, ski station, 31TCH0014, 1950 m, 2 Aug 1999, *L. Delgado 281 & M.M. Martínez-Ortega* (SALA 110805); Spain, Huesca, Ansó, sunny side of Bar-ranco de Petrachema, way to Petrachema pass, 30TXN8352, 1800 m, 25 Jun 2000, *L. Delgado 330 & I. Soriano* (SALA 110801); Spain, Huesca, Ansó, Linza shelter, 30TXN8052, 1400 m, 25 Jun 2000, *L. Delgado 320 & I. Soriano* (SALA 110803); Spain, Huesca, Sallent de Gállego, Respomuso reservoir, Respomuso shelter, 30TYN2144, 2100 m, 22 Jul 1998, *S. Bernardos, L. Delgado 73 & J.A. Sánchez-Agudo* (SALA 110804); Spain, Lérida, Alto Arán, Pla de Beret, 31TCH3334, 2000 m, 28 Jun 2000, *L. Delgado 345 & I. Soriano* (SALA 110802); Spain, Navarra, Isaba, Portillo de Arrasarguiat, 30TXN8259, 1700 m, 26 Jun 2000, *L. Delgado 336 & I. Soriano* (SALA 110800) [Fig. 5L].

The ploidy level ($2x$) found in the studied populations of this endemic species of the Iberian Peninsula (Pyrenean and Cantabrian Mts.) agrees with that obtained from Pyrenean (Küpfer & Favarger, 1967; Favarger & Küpfer, 1968) and Cantabrian populations (Küpfer, 1974).

▼ *Pedicularis rosea* subsp. *allionii* (Rchb.f.) E.Mayer

$2n = 16$, CHN. Spain, Lérida, Alto Arán, Arán Valley, Pla de Beret, 31TCH3135, 2350 m, 28 Jun 2000, *L. Delgado 347 & I. Soriano* (SALA 110815) [Fig. 5M].

This is the first chromosome count conducted from a Spanish accession.

▼ *Pedicularis rostratocapitata* Crantz

$2n = 16$, CHN. Austria, Steiermark, Gröbming, ascent to Stoderzinken, 33TVN15, 2040 m, 15 Jul 2000, *D. Albach, L. Delgado, M.M. Martínez-Ortega, J.A. Sánchez-Agudo & E. Rico 7548* (SALA 118456) [Fig. 5N]; Italy, Venice, Misurina, Tre Cime di Lavaredo, 33TTM9265, 2450 m, 18 Jul 2000, *L. Delgado, M.M. Martínez-Ortega, J.A. Sánchez-Agudo & E. Rico 7641* (SALA 118544), *L. Delgado, M.M. Martínez-Ortega, J.A. Sánchez-Agudo & E. Rico 7651* (SALA 118555).

Our chromosome counts ($2n = 16$) agree with those previously carried out in material from the Austrian Alps (cf. Dobeš & Vitek, 2000). These are the first counts from Italian accessions.

* *Pedicularis schizocalyx* (Lange) Steininger

$n = 16$, CHN. Spain, León, Ponferrada, Villanueva de Valdeuza, Los Apóstoles, to the Guiana, 29TPH9702, 1500 m, 13 Jun 2000, *L. Delgado 312 & M.M. Martínez-Ortega* (SALA 110787) [Fig. 5O].

$n = 16$, $2n = 32$, CHN. Spain, Ávila, Santiago del Collado, Peña Negra pass, 30TUK0377, 1500 m, 10 May 2000, *L. Delgado 301, K. Marhold & M.M. Martínez-Ortega* (SALA 110790) [Fig. 5P,Q].

$2n = 32$, CHN. Spain, Ávila, Santiago del Collado, Peña Negra pass, 30TUK0377, 1500 m, 17 Jun 1998, *L. Delgado L22 & E. Rico* (SALA 110786); Spain, Ávila, Santiago del Collado, Peña Negra pass, 30TUK0377 1500 m, 15 May 1999, *L. Delgado 161* (SALA 110788) [Fig. 5R]; Spain, La Rioja, Pedroso, Sierra de Cameros Nuevo, El Risco, 30TWM2780, 1380 m, 16 Jun 1999, *L. Delgado 203 & M.M. Martínez-Ortega* (SALA 110785); Spain, Salamanca, Peñaparda, Alquería de Perosín, 29TPE9761, 860 m, 22 May 2001, *L. Delgado 762* (SALA 110789); Spain, Segovia, Riofrío de Riaza, Quesera pass, 30TVL6463, 1700 m, 30 May 1999, *L. Delgado, M.M. Martínez-Ortega 627 & J.A. Sánchez-Agudo* (SALA 110792); Spain, Zamora, Galende, San Martín de Castañeda, El Gencianal, 29TPG8669, 1650 m, 16 Jun 2002, *P. Bariego & L. Delgado 824*

(SALA 110791); Spain, Zamora, Galende, San Martín de Castañeda, Peñón Richana, 29TPG8570, 1792 m, 16 Jun 2002, *P. Bariego* & *L. Delgado* 825 (SALA 110793).

These are the first chromosome counts for this species endemic to the NW of the Iberian Peninsula. Nine populations distributed throughout the species range were studied, and the tetraploid level was repeatedly obtained ($2n = 4x = 32$). The haploid number ($n = 16$) was counted from pollen grain mitosis (Fig. 5O) and metaphase I in pollen mother cells (Fig. 5P), whereas the diploid number ($2n = 32$) was counted in mitotic metaphase in somatic cells of the gynoeceum (Fig. 5Q,R).

Pedicularis – with between 500 and 600 species described – is one of the most species-rich genera of the angiosperms (Fischer, 2004; Ree, 2005; Soriano, 2009). The chromosome number is known for only 146 species and/or subspecies (Rice & al., 2015). Polyploidy does not seem to play a relevant role in speciation within *Pedicularis* given the low number of identified polyploid species (all of them tetraploids, i.e., $2n = 4x = 28$; $2n = 4x = 32$). There are currently 13 known polyploid taxa, one of them with a basic chromosome number $x = 7$ (*P. anserantha* var. *elevatogaleata* (T.Yamaz.) T.Yamaz.) and 12 with $x = 8$ (cf. Bolkhovskikh & al., 1969; Moore, 1973; Goldblatt & Johnson, 1979+; Goldblatt, 1981). The taxa within *Pedicularis* that seem to be exclusively tetraploids according to the available literature are *P. brachyodonta* Schloss. & Vuk., *P. sceptrum-carolinum* L. and *P. schizocalyx* in Europe; *P. cystopteridifolia* Rydb. and *P. procera* A.Gray in North America; and *P. anserantha* var. *elevatogaleata*, *P. apodochila* Maxim. and *P. sudetica* subsp. *gymnostachya* (Trautv.) Jurtzev & V.V.Petrovsky in Asia. The diploid-tetraploid species are *P. hirsuta* L., *P. hoffmeisteri* Klotzsch, *P. pauciflora* (Prain) Pennell, *P. sylvatica* L. and *P. villosa* Ledeb. ex Spreng.

Pedicularis sibthorpii Boiss.

$2n = 16$, CHN. Turkey, Bolu, south of Abant Gölü, 36TUK59, 40°35'N, 31°17'E, 1400 m, 18 Jun 2001, *C. Aedo* 6154 & al. (SALA 119845) [Fig. 5S,T].

Our data agree with those reported by Magulaev (1984) for plants collected in the Caucasus.

* *Pedicularis sylvatica* subsp. *lusitanica* (Hoffmanns. & Link) Cout.

$2n = 16$, CHN. Spain, Cádiz, Jerez de la Frontera, Sierra de la Gallina, 30STF7552, 640 m, 27 Apr 1999, *F. Amich*, *S. Bernardos*, *L. Delgado* 119, *E. Rico* & *J.A. Sánchez Rodríguez* (SALA 110780); Spain, Salamanca, Aldehuela de Yeltes, Laguna del Cristo, 29TQF3307, 850 m, 16 Jun 1998, *L. Delgado* 34-4, *X. Giraldez* & *E. Rico* (SALA 110779); Spain, Segovia, Fuente el Olmo de Fuentidueña, 30TVL1581, 850 m, 30 May 1999, *L. Delgado* & *M.M. Martínez-Ortega* 6283 (SALA 110781) [Fig. 6A].

These chromosomal counts are the first carried out in this taxon, distributed in the western half of the Iberian Peninsula and NW Africa. Our data confirm the ploidy level estimations for the species conducted in three populations in Portugal by Castro & al. (2012).

▼ *Pedicularis sylvatica* L. subsp. *sylvatica*

$2n = 16$, CHN. Spain, Ávila, Villarejo del Valle, Pico pass, 30TUK2965, 1390 m, 15 May 1999, *L. Delgado* 162 (SALA 110776) [Fig. 6B]; Spain, Cantabria, Camaleño, Fuente Dé, 30TUN5278, 1100 m, 28 May 1998, *L. Delgado* 15, *E. Rico*, *J.A. Sánchez Rodríguez* & *C. Valle Gutiérrez* (SALA 110775); Spain, León, Villagatón, Manzanal del Puerto, 29TQH2719, 1100 m,

9 May 2000, *L. Delgado* 300, *K. Marhold*, *E. Rico* & *J.A. Sánchez-Agudo* (SALA 110777); Spain, Lérida, Bonaigua pass, 31TCH3425, 2100 m, 31 Jul 1999, *L. Delgado* 270 & *M.M. Martínez-Ortega* (SALA 110778); Spain, Vitoria, Parzonería de Entzia, Sierra de Eutzia, El Mojón, 30TWN5939, 1000 m, 24 Jun 1998, *L. Delgado* 44, *J. Hernández*, *M.M. Martínez-Ortega* & *E. Rico* (SALA 110774).

Our data match the chromosome counts previously conducted by different authors (cf. Bolkhovskikh & al., 1969; Moore, 1973; Goldblatt & Johnson, 1979+). These are the first counts from Spanish accessions.

▼ *Pedicularis tuberosa* L.

$2n = 16$, CHN. Spain, Huesca, Ansó, sunny side of Barranco de Petrachema, 30TXN8152, 1600 m, 25 Jun 2000, *L. Delgado* 324 & *I. Soriano* (SALA 110794); Spain, Huesca, Ansó, sunny side of Barranco de Petrachema, way to Petrachema pass, 30TXN8352, 1800 m, 25 Jun 2000, *L. Delgado* 329 & *I. Soriano* (SALA 110795); Spain, Navarra, Isaba, Portillo de Arrasarguiat, 30TXN8059, 1600 m, 26 Jun 2000, *L. Delgado* 334 & *I. Soriano* (SALA 110798) [Fig. 6C].

Our data agree with the number reported for central European populations (cf. Bolkhovskikh & al., 1969; Dobeš & Vitek, 2000). These are the first counts from Spanish accessions.

* *Pedicularis verticillata* subsp. *caespitosa* (Webb) I.Soriano

$2n = 12$, CHN. Spain, Granada, Capileira, Laguna de Aguasverdes, 30SVG6700, 3052 m, 11 Jul 2007, *E. Rico* & *M. Santos-Vicente* 925 (SALA 134815) [Fig. 6D,E].

This chromosomal count is the first carried out in this Iberian endemic, exclusive to the Sierra Nevada (Soriano, 2009). The number $2n = 12$ has been confirmed in gynoeceum cell mitosis metaphases and agrees with the number counted in the nominate subspecies.

▼ *Pedicularis verticillata* L. subsp. *verticillata*

$n = 6$, $2n = 12$, CHN. Spain, Asturias, Quirós, Ventana pass, 29TQH4372, 1560 m, 27 Jun 1999, *L. Delgado* 230 & *M.M. Martínez-Ortega* (SALA 110816) [Fig. 6F–J]; Spain, Palencia, La Pernía, Redondo-Areños, Piedrasluengas pass, 30TUN8165, 1300 m, 30 May 1998, *L. Delgado* 22, *E. Rico*, *J.A. Sánchez Rodríguez* & *C. Valle Gutiérrez* (SALA 110818).

$2n = 12$, CHN. Italy, Abruzzo, L'Aquila, Campo Imperatore, 33TUH8100, 2100 m, 30 Jun 2002, *C. Aedo* 8288 & al. (SALA 135318); Italy, Venice, Misurina, Tre Cime di Lavaredo, 33TTM9265, 2450 m, 18 Jul 2000, *L. Delgado*, *M.M. Martínez-Ortega*, *J.A. Sánchez-Agudo* & *E. Rico* 7660 (SALA 118565) [Fig. 6K]; Spain, León, Crémenes, Lois, between Canto Montote and Peñón de la Collada, 30TUN2661, 1350 m, 15 Jun 2000, *L. Delgado* 318 & *M.M. Martínez-Ortega* (SALA 110819) [Fig. 6L]; Spain, Cantabria, Fuente Dé, 30TUN5278, 1200 m, 28 May 1998, *L. Delgado* 14, *E. Rico*, *J.A. Sánchez Rodríguez* & *C. Valle Gutiérrez* (SALA 110817).

Our data agree with the numerous counts ($n = 6$, $2n = 12$) carried out from different parts of the distribution area of this circum-boreal species (cf. Bolkhovskikh & al., 1969; Moore, 1973, 1977; Goldblatt & Johnson, 1979+). The haploid chromosome number has been counted at prophase I, anaphase I, and metaphase II, in pollen mother cells (Fig. 3F–I). These are the first counts from Italian accessions.

▼ *Rhinanthus alectorolophus* (Scop.) Pollich

$2n = 14$; $2n = 14 + 8B$, CHN. France, Department of Savoie, Lanslebourg, ascent to Mont Cenis pass, 32TLR3316, 1800 m, 8 Jul

2000, *L. Delgado, M.M. Martínez-Ortega 937, J.A. Sánchez-Agudo & E. Rico* (SALA 118003).

Our results confirm previously published chromosome numbers for this species (cf. Bolkhovskikh & al., 1969; Moore, 1973; Goldblatt & Johnson, 1979+). This is the first count from a French accession.

Rhinanthus glacialis Personnat

$n = 7$, $2n = 14$, CHN. Austria, Steiermark, Weyern quarry towards Gröbming, 33TVN15, 886 m, 14 Jul 2000, *D. Albach, L. Delgado, M.M. Martínez-Ortega, J.A. Sánchez-Agudo 115 & E. Rico* (SALA 118165).

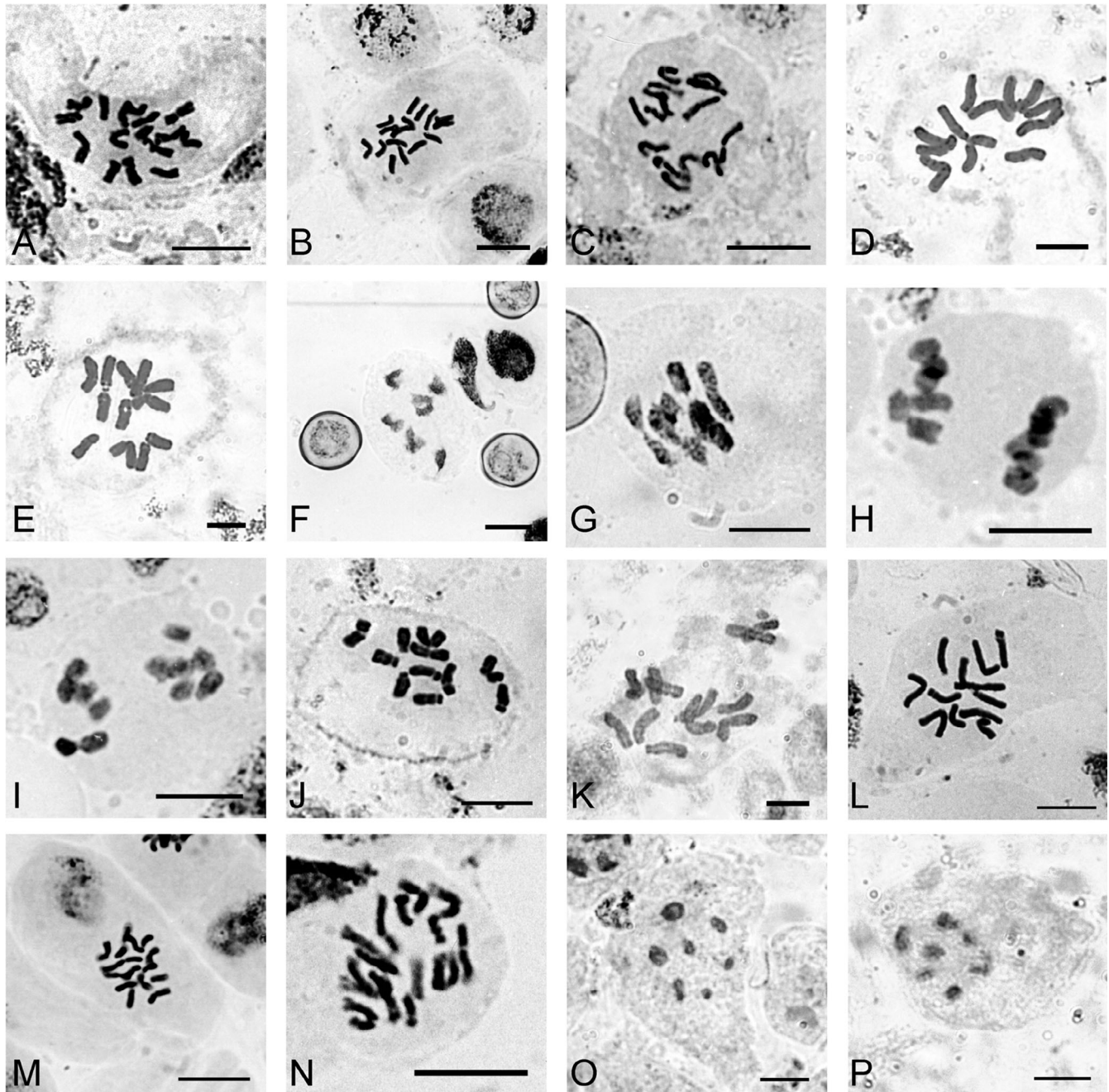


Fig. 6. A–E, Mitotic metaphases, $2n = 16$: A, *Pedicularis sylvatica* subsp. *lusitanica* (SALA 110781); B, *P. sylvatica* subsp. *sylvatica* (SALA 110776); C, *P. tuberosa* (SALA 110798); D & E, *P. verticillata* subsp. *caespitosa* (SALA 134815). F–I, *P. verticillata* subsp. *verticillata*, meiosis in pollen mother cell, $n = 6$ (SALA 110816): F, Prophase I; G, Metaphase I; H, Anaphase I; I, Anaphase II. J–L, *P. verticillata* subsp. *verticillata*, mitotic metaphase, $2n = 12$: J, (SALA 110816); K, (SALA 118565); L, (SALA 110819). M, *Rhinanthus glacialis*, meiotic metaphase I in pollen mother cell, $n = 7$ (SALA 118410). N, *Rh. minor*, meiotic metaphase I in pollen mother cell, $n = 7$ (SALA 118236). O & P, *Pedicularis pyrenaica* × *P. tuberosa*, mitotic metaphase, $2n = 16$ (SALA 110821). — Scale bars = 10 μ m.

$2n = 14$, CHN. Austria, Kärnten, Tauerneck, Glockner massif, 33TUN31, 17 Jul 2000, *L. Delgado 561*, *M.M. Martínez-Ortega*, *J.A. Sánchez-Agudo & E. Rico* (SALA 118410) [Fig. 6M].

▼ *Rhinanthus minor* L.

$n = 7$, CHN. Italy, Udine, Gemona del Friuli, Monte Quarnan, 33TUM5926, 1050 m, 10 Jul 2000, *L. Delgado 375*, *M.M. Martínez-Ortega*, *J.A. Sánchez-Agudo & E. Rico* (SALA 118236) [Fig. 6N].

The chromosome number reported for this species ($n = 7$) agrees with the data published in the literature (cf. Bolkhovskikh & al., 1969; Moore, 1973; Goldblatt & Johnson, 1979+; Delgado & al., 2015). This is the first count from an Italian accession.

Naturally occurring interspecific hybrids

* *Pedicularis mixta* Gren. × *P. praetermissa* (I.Soriano, M.Bernal & A.Sánchez-Cux.) Aymerich & L.Sáez (*P. × aranensis* I.Soriano)

$2n = 16$, CHN. Spain, Lérida, Alto Arán, Arán Valley, Pla de Beret, 31TCH3434, 1800 m, 28 Jun 2000, *L. Delgado 353 & I. Soriano* (SALA 110820).

This hybrid between *Pedicularis mixta* and *P. praetermissa* (an endemic species of central Pyrenees) is only known from near Pla de Beret (Val d'Aran, Central Pyrenees), in wetlands (Soriano, 2018). The chromosome count has been carried out in mitotic metaphases of gynoecia, and no chromosome abnormality was found. The ploidy level ($2x$) was coincident with that of *P. mixta* and probably also with that of *P. praetermissa* (chromosome number unknown in this case).

* *Pedicularis pyrenaica* J.Gay × *P. tuberosa* L. (*P. × pallidiflora* I.Soriano)

$2n = 16$, CHN. Spain, Huesca, Ansó, sunny side of Barranco de Petrachema, 30TXN8152, 1600 m, 25 Jun 2000, *L. Delgado 325 & I. Soriano* (SALA 110797); Spain, Huesca, Ansó, sunny side of Barranco de Petrachema, 30TXN8152, 1600 m, 25 Jun 2000, *L. Delgado 326 & I. Soriano* (SALA 110796); Spain, Navarra, Isaba, Portillo de Arrasarguiat, 30TXN8159, 1650–1700 m, 26 Jun 2000, *L. Delgado 335 & I. Soriano* (SALA 110821) [Fig. 6O,P].

Pedicularis × pallidiflora is a hybrid located in the valleys of the western (Roncal and Ansó) and central Pyrenees (Espot), where it cohabits with its putative parental species: *P. pyrenaica* and *P. tuberosa* (Soriano, 2009, 2018). Three populations of this nothotaxon have been studied, and the chromosomal number counted was the same as that of the parentals, $2n = 16$ (Fig. 6O,P).

METHODS

All cytological investigations have been carried out on anthers and gynoecia of young floral buds collected in the field. Floral buds were fixed in Carnoy's solution (absolute ethanol-glacial acetic acid, 3 : 1), stained in 2% acetic orcein (La Cour, 1945) and squashed in 45% acetic acid.

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IAPT chromosome data 33/4

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* First chromosome count for the family.

** First chromosome count for the genus.

CYPERACEAE

Subfamily Cyperoideae

** *Becquerelia cymosa* Brongn.

$2n = 40$, CHN. Brazil, Paraíba, Jacaraú, 06°38'13"S, 35°14'49"W; 148 m, 11 Aug 2019, *E.M. Almeida 2856 & M. Fernandes* (EAN 29294) [Fig. 7A].

Subfamily Mapanioideae

** *Diplasia karatifolia* Rich.

$2n = 60$, CHN. Brazil, Amazonas, Manaus, Reserva Adolpho Ducke, near the field camp facilities at the Acará stream, 26 Sep 2018, *M. Alves & Y. Dias 04-2018* (UFP) [Fig. 7B].

** *Hypolytrum schraderianum* Nees

$2n = 60$, CHN. Brazil, Amazonas, Manaus, Reserva Adolpho Ducke, access to the observation tower trail, 26 Sep 2018, *M. Alves & Y. Dias 05-2018* (UFP) [Fig. 7C]. Brazil, Bahia, Mun. Camacan, Serra Bonita Private Reserve (RPPN), 15°25'07"S, 39°32'58"W, 300–400 m, 20 Sep 2018, *W.W. Thomas, P.J.S. Silva Filho & L.H. Daneu 16811* (JPB, NYBG) [Fig. 7D].

$2n = 76$, CHN. Brazil, Paraná, Paranaguá, Ilha do Mel, near Bica do Norinho at 25°33'59.9"S, 48°18'25.7"W, 2 Jul 1995, *M.C. Dias & E. Rocha s.n.* (FUEL 29197, HCF 9642, VIES 26685), recollected in 2019 for the present analysis [Fig. 7E].

THURNIACEAE

* *Prionium serratum* (L.f.) Drège ex E.Mey.

$2n = 46$, CHN. South Africa, Western Cape, Groot Winterhoek Wilderness Area, on edge of trail near Disa Pool, approximately 1 km from parking lot, 32°59'54.132"S, 19°04'13.9368"W, 924 m, 20 Oct 2018, *T.L. Elliott TE2016_413* (BOL) [Fig. 7F].

* *Thurnia sphaerocephala* (Rudge) Hook.f.

$2n = 46$, CHN. Brazil, Amazonas, Manaus, Reserva Florestal Adolpho Ducke, stream near communal kitchen for the local lodging, 27 Sep 2018, *M. Alves & Y. Dias 10-2018* (UFP) [Fig. 7G].

The families Cyperaceae, Juncaceae and Thurniaceae form the well-supported Cyperid clade (Chase & al., 2006), which also includes Rapateaceae and Mayacaceae, although with low support (Bouchenak-Khelladi & al., 2014). Cyperaceae has a cosmopolitan distribution, but it originated in South America and diversified in the Northern Hemisphere (Spalink & al., 2016). It comprises 90 genera and about 5500 species distributed in two subfamilies (Cyperoideae and Mapanioideae), constituting the third-largest family of monocotyledons in species diversity, after Orchidaceae and Poaceae (Semmoury & al., 2019; Govaerts & al., 2020). Some Cyperaceae species, such as *Cyperus esculentus* L., *C. papyrus* L. and *C. rotundus* L., are economically important and relevant for ethnobotany and horticulture (Simpson & Inglis, 2001). Sister to Cyperaceae-Juncaceae, Thurniaceae is composed of four species belonging to two genera (*Thurnia* Hook.f. and *Prionium* E.Mey.), namely *Thurnia jenmanii* Hook.f., *T. polycephala* Schnee, *T. sphaerocephala* (Rudge) Hook.f., which are endemic to the northeastern part of the Amazon Basin, and *Prionium serratum* (L.f.) Drège ex E.Mey, endemic to South Africa (Kubitzki, 1998; Mucina & Rutherford, 2006).

Several cytogenetic studies have been performed in Cyperaceae, especially addressing the high diversity of chromosome numbers, which range from $2n = 4$ to 224, with probable ancestral number $x = 5$, and the high variability of rDNA sites (Roalson, 2008; da Silva & al., 2010; Sousa & al., 2011; Lipnerová & al., 2013; Ribeiro & al., 2018; Carta & al., 2020). However, the subfamily Mapanioideae is still underrepresented and has only one chromosome count, for *Chrysitrix capensis* L., with $2n = 46$ (Márquez-Corro & al., 2018).

Holocentricity is one of the most striking cytogenetic characteristics of the family, being a synapomorphy for Cyperaceae and the sister group, Juncaceae (Greilhuber, 1995). Chromosomal fusions and fissions leading to dysploidy, polyploidy, inverted meiosis and variation in genome size are part of the evolutionary dynamics of Cyperaceae, and some of these features are related to holocentricity (Vanzela & al., 2000; Hipp & al., 2009; Cabral & al., 2014; Ribeiro & al., 2018; Souza & al., 2018). Although the Cyperid clade is recognized as holocentric, there is no evidence for it outside Cyperaceae and Juncaceae. In fact, our work provides the first chromosome counts for the family Thurniaceae.

For slide preparations, root tips were pretreated with 2 mM 8-hydroxyquinoline for 24 h at 10°C, fixed in ethanol : acetic acid (3 : 1, v : v) for 2 h and stored at –20°C. After enzymatic digestion (2% cellulase Onozuka, 20% pectinase Sigma, or 2% cellulase, 2% pectolyase, 20% pectinase, Sigma, both in 0.01 M citric acid–sodium citrate buffer, pH 4.8) for 90 min at 37°C, mitotic preparations were performed by air-drying (Carvalho & Saraiva, 1993) or by squashing in a drop of 45% acetic acid. Slides were selected after staining with 2 µg/ml of DAPI (4',6-diamidino-2-phenylindole, Sigma) in glycerol (1 : 1, v : v).

For all analysed species, which showed small chromosomes (around 1 µm) of decreasing sizes, chromosomal numbers were counted for the first time. *Becquerelia cymosa* showed $2n = 40$ (Fig. 7A). *Diplasia karatifolia* and *H. schraderianum* from the states of Amazonas and Bahia had $2n = 60$ (Fig. 7B–D), while *H. schraderianum* from Paraná showed $2n = 76$ (Fig. 7E). *Prionium serratum* and *T. sphaerocephala* had $2n = 46$ (Fig. 7F,G). Primary constrictions have not been clearly observed in any sample, but this may be due to their small chromosome sizes. Thus, holocentricity should be evaluated by other approaches. Although intraspecific variability was observed for *H. schraderianum*, the same chromosome number was observed in the two studied genera of subfamily Mapanioideae, *Diplasia* Rich. and *Hypolytrum* Pers., which belong to different

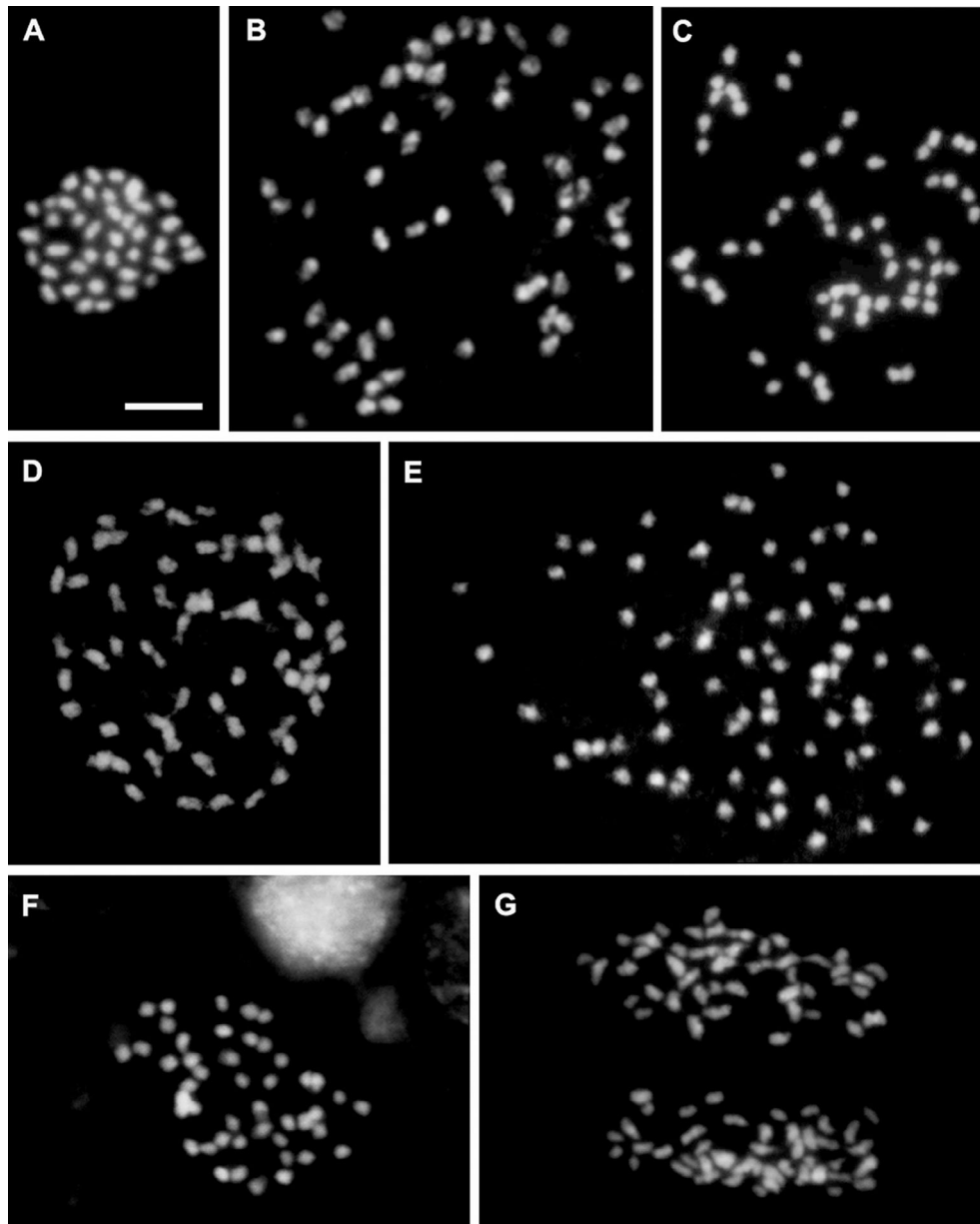


Fig. 7. Mitotic metaphase (A–F) and anaphase (G) chromosomes of: **A**, *Becquerelia cymosa*, $2n = 40$; **B**, *Diplasia karatifolia*, $2n = 60$; **C**, *Hypolytrum schraderianum* from Amazonas State, $2n = 60$; **D**, *Hypolytrum schraderianum* from Bahia State, $2n = 60$; **E**, *Hypolytrum schraderianum* from Paraná State, $2n = 76$; **F**, *Prionium serratum*, $2n = 46$; **G**, *Thurnia sphaerocephala*, $2n = 46$. — Scale bar in A = 5 μm .

phylogenetic subclades (Semmoury & al., 2019). Similarly, the same chromosome number was observed for both Thurniaceae genera. This study provides information on early-diverging lineages of Cyperids and suggests that dysploidy and polyploidy are relevant in the evolution of this clade.

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IAPT chromosome data 33/5

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Mitotic metaphase chromosomes were examined in root tips of seedlings, bulbs or young leaves. The method followed Smirnov (1968). Chromosome numbers in literature were checked using CCDB v.1.45 (Rice & al., 2015).

* First chromosome count for the species.

FABACEAE (LEGUMINOSAE)

Caragana grandiflora DC.

$2n = 16$, CHN. Russia, Kabardino-Balkaria Republic, Cherekskii Raion, Bol'shoi Kavkazskii Range, Cherekskoe Gorge, left bank of the Cherek Balkarskii River, over the former Zilgi (Zylgi) village, rocky slope, 1150 m, 43°09'16"N, 43°28'28"E, 8 Aug 2019, R.A. Murtazaliev 58881 (IRK).

Galega orientalis Lam.

$2n = 16$, CHN. Russia, Kabardino-Balkaria Republic, Cherekskii Raion, Bol'shoi Kavkazskii Range, Cherekskoe Gorge, left bank of the Cherek Balkarskii River, former Zilgi (Zylgi) village, abandoned apple trees garden, 1150 m, 43°09'16"N, 43°28'28"E, 8 Aug 2019, D.A. Krivenko 59068 (IRK).

Vavilovia formosa (Steven) Fed. (\equiv *Pisum formosum* (Steven) Alef.)

$2n = 14$, CHN. Russia, Republic of Dagestan, Dokuzparinskii Raion, Bol'shoi Kavkazskii Range, 4 km SSW of Kurush village, slope of Nesindag Mt., right bank of the Ragdanchai River (right

tributary of Mullarchai River; Chekhychai River basin), steep stony (composed of porphyrite and shale) slope, 2780 m, 41°14'50"N, 47°48'05"E, 15 Aug 2019, D.A. Krivenko, Z.A. Guseinova & R.A. Murtazaliev 58156 (IRK, TASH).

Vicia hololasia Woronow

2n = 10, Russia, Republic of Dagestan, Derbent city, Sarykaya terrain near the Naryn-Kala citadel of Derbent fortress, 7 May 2019, R.A. Murtazaliev s.n. (DAG).

LILIACEAE

* *Tulipa mongolica* Y.Z.Zhao

2n = 24, CHN. Russia, Zabaikalskii Krai, Aginskii Buryatskii Okrug, Aginskii Raion, right bank of the Onon River, 4 km WNW of Nizhnii Tsasuchei village, Malyi Bator tract, steppe slope, 667 m, 50°31'14"N, 115°01'32"E, 29 Apr 2019, O.A. Chernysheva, L.I. Sarajeva, A.S. Erst, E.R. Khadeeva & D.A. Krivenko 53652 (IRK) [Fig. 8H].

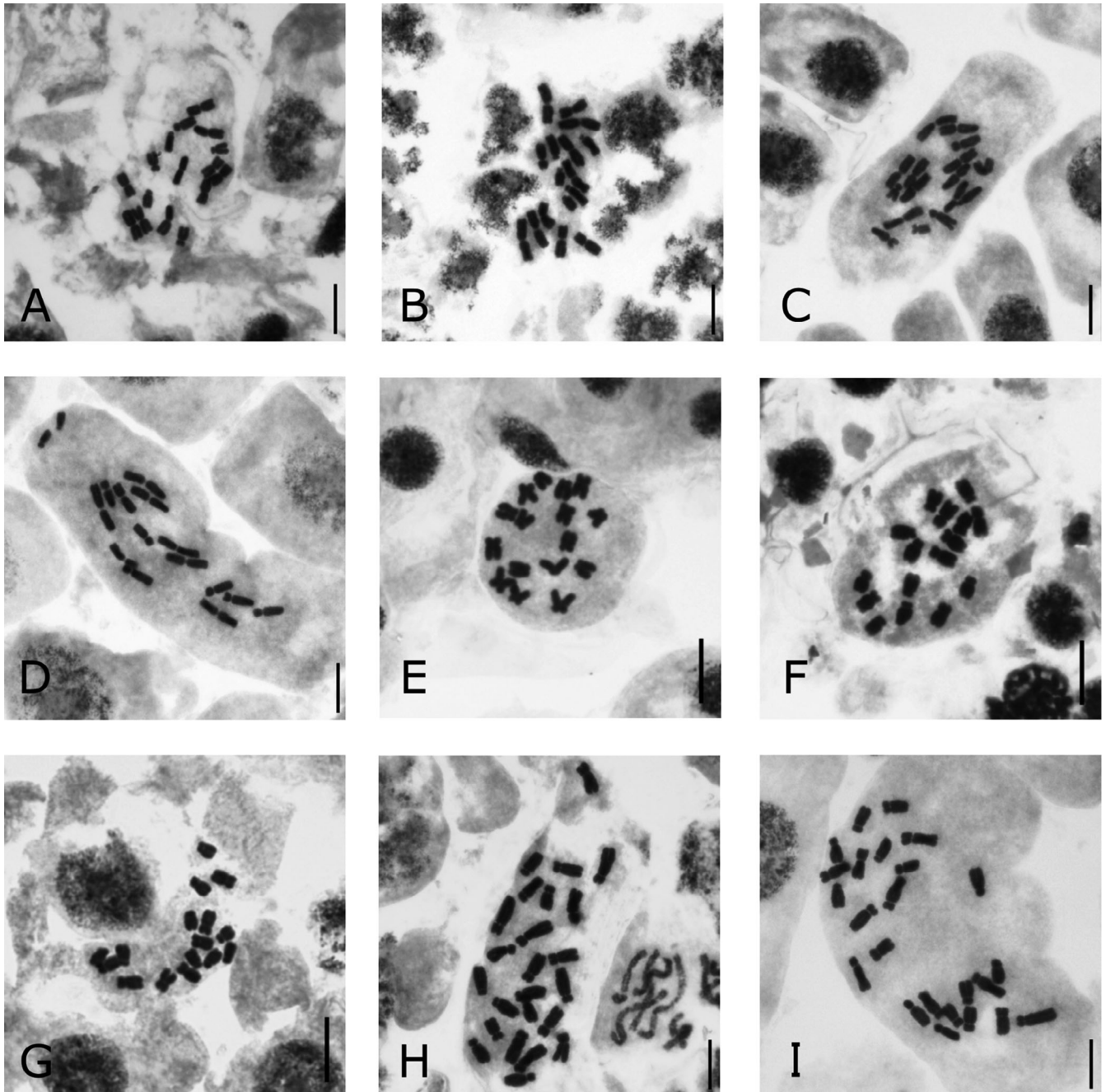


Fig. 8. Mitotic metaphase chromosomes: **A**, *Eranthis bulgarica*, 2n = 16; **B**, *Eranthis byunsanensis*, 2n = 16; **C**, *Eranthis cilicica*, 2n = 16; **D**, *Eranthis pinnatifida*, 2n = 16; **E**, *Trollius austrosibiricus*, 2n = 16; **F**, *Trollius irtuticus*, 2n = 16; **G**, *Trollius riederianus*, 2n = 16; **H**, *Tulipa mongolica*, 2n = 24; **I**, *Tulipa uniflora*, 2n = 24. — Scale bars = 10 μ m.

Tulipa uniflora (L.) Besser ex Baker

$2n = 24$, CHN. Russia, Irkutskaya Oblast', Ust'-Ordynskii Buryatskii Okrug, Ekhirit-Bulagatskii Raion, right bank of the Kuda River, vicinity of Gakhany village, steppe slope of E exposure, 600 m, 53°02'05.1"N, 104°52'46.8"E, 6 May 2017, *O.A. Chernysheva & D.A. Krivenko 48972* (IRK, MW); Russia, Irkutskaya Oblast', Ust'-Udinskii Raion, 2.5 km NW of Igzhei settlement, motley grass-cereal steppe slope of SW exposure, 535 m, 54°03'25.7"N, 103°05'31.0"E, 10 May 2017, *O.A. Chernysheva & D.A. Krivenko 48966* (IRK, LE); Russia, Irkutskaya Oblast', Ust'-Ordynskii Buryatskii Okrug, Osinskii Raion, near the Obusa village, steppe slope of SW exposure, 528 m, 53°43'18.2"N, 103°49'15.0"E, 12 May 2017, *O.A. Chernysheva & D.A. Krivenko 48976* (IRK); Russia, Irkutskaya Oblast', Ust'-Ordynskii Buryatskii Okrug, Bokhanskii Raion, right bank of the Ida River, 2 km SW of Khandagai village, 445 m, steppe slope of SW exposure, 53°11'12.5"N, 103°37'01.7"E, 13 May 2017, *O.A. Chernysheva & D.A. Krivenko 48978* (IRK) [Fig. 8I].

RANUNCULACEAE*Adonis sibirica* Patrín ex Ledeb.

$2n = 24$, CHN. Russia, Irkutskaya Oblast', Kuitunkii Raion, 5 km SE of Mintagui village, burnt birch forest, at the road, 54°24'19.70"N, 101°21'23.00"E, 12 May 2020, *O.A. Chernysheva 59064* (IRK, NS).

Anemone caerulea DC. (≡ *Anemonoides caerulea* (DC.) Holub)

$2n = 16$, CHN. Russia, Republic of Altai, Ust'-Kanskii Raion, Ust'-Kan village, edge of a larch forest, N slope, 1020 m, 50°56'05"N, 84°43'47"E, 4 Jun 2020, *A.S. Erst, T.V. Erst & E.V. Boltenkov 09* (NS).

Anemone sylvestris L. (≡ *Anemonoides sylvestris* (L.) Galasso, Banfi & Soldano)

$2n = 16$, CHN. Russia, Novosibirskaya Oblast', Iskitimskii Raion, Sosnovka village, 54°40'14.4"N, 82°55'45.9"E, 17 May 2020, *A.S. Erst & T.V. Erst s.n.* (NS).

Callianthemum angustifolium Witasek

$2n = 16$, CHN. Russia, Republic of Altai, Ulaganskii Raion, near the Aktash village, 50°20'24.6"N, 87°44'48.0"E, 12 Jul 2018, *A.S. Erst 439* (NS).

* *Eranthis bulgarica* (Stef.) Stef.

$2n = 16$, CHN. Bulgaria, Vidin District, Vrashka Chuka Peak, in the xerothermal belt of oak forests, 632 m, 43°50'14.2"N, 22°22'30.3"E, 12 Mar 2019, *A. Tashev 001* (SOM) [Fig. 8A].

Eranthis byunsanensis B.Y.Sun.

$2n = 16$, CHN. South Korea, Gyeonggi-do, Anyang-si, Suli-san, 190 m, 37°21'42.8"N, 126°54'01.9"E, 24 Mar 2019, *H. Ikeda, H.-T. Im, K.-S. Chung, M. Fujii, M. Sakamoto & C. Hasekura 19032401* (NS) [Fig. 8B].

Eranthis cilicica Schott & Kotschy

$2n = 16$, CHN. Turkey, Kahramanmaraş Province, Göksun District, Delihöbek Dagi, mountain steppe, 2115 m, 37°53'00"N, 36°41'00"E, 29 Apr 2019, *T. Ertugrul 1062* (GAZI) [Fig. 8C].

Eranthis hyemalis (L.) Salisb.

$2n = 16$, CHN. Italy, Via di Roncrio, Bologna (BO), mixed wood near the road, 123 m, 44°27'42.1"N, 11°20'12.9"E, 16 Feb 2020, *A.S. Erst, T.V. Erst & L. Pinzani 005* (NS).

Eranthis pinnatifida Maxim.

$2n = 16$, CHN. Japan, Saitama Prefecture, Chichibu Shi City, Shiroku, 340 m, 35°57'23.6"N, 138°59'15.6"E, 2 Apr 2019, *A.S. Erst, T.V. Erst & H. Ikeda 001* (NS); Japan, Mie Prefecture, Inabeschi, Fujiwara-cho, Ogaito, 180 m, 35°10'10.6"N, 136°28'35.2"E, 3 Apr 2019, *A.S. Erst, T.V. Erst & H. Ikeda 002* (NS); Japan, Hokuseicho Betsumyo, Inabe, 640 m, 35°08'22.6"N, 136°28'20.0"E, 3 Apr 2019, *A.S. Erst, T.V. Erst & H. Ikeda 005* (NS); Japan, Nagano Prefecture, Hideshio Station, 825 m, 36°02'58.0"N, 137°53'44.7"E, 4 Apr 2019, *A.S. Erst, T.V. Erst & H. Ikeda 006* (NS) [Fig. 8D].

Eranthis stellata Maxim.

$2n = 16$, CHN. P. R. China, Jilin Province, Fusong County, Baishan city, Changbai Mt., 852 m, 42°06'55.5"N, 127°30'29.0"E, 29 Apr 2019, *K. Xiang 001* (PE); Russia, Amurskaya Oblast', Bureisky Raion, left bank of the Cinel' River, birch-larch forest, 50°14'38.3"N, 130°11'01.2"E, 195 m, 6 May 2020, *T.N. Veklich 001* (NS).

* *Trollius austrosibiricus* Erst & Lufarov

$2n = 16$, CHN. Russia, Republic of Altai, Kosh-Agachskii Raion, Verkhnee Boguty Lake, mountain steppe, 2475 m, 49°42'52.8"N, 89°29'48.3"E, 8 Jun 2020, *A.S. Erst, T.V. Erst & E.V. Boltenkov 036* (NS) [Fig. 8E].

Trollius chinensis Bunge

$2n = 16$, CHN. Russia, Primorskii Krai, Mikhailovskii Raion, Gornii village, Skalistaya Mt., broad-leaved forest with mongolian oak, 43°59'34.6"N, 132°20'06.1"E, 253 m, 6 Jun 2018, *V. Yakubov 001* (NS); Primorskii Krai, Khasanskii Raion, near Kraskino village, 42°42'23.8"N, 130°50'08.8"E, 10 Jun 2017, *M. Koldaeva 001* (NS).

Trollius irtuticus Sipliv.

$2n = 16$, CHN. Russia, Irkutskaya Oblast', Cheremkhovskii Raion, left bank of the Onot River, 0.5 km SW of Onot village, rocky spit along the riverbank overgrown with small willows and sphagnum, 52°43'58.0"N, 102°02'01.9"E, 13 May 2020, *O.A. Chernysheva 59078* (IRK, NS); Russia, Republic of Buryatiya, Kabanskii Raion, Bolshoi Mamai River, mixed forest, 51°23'30.1"N, 104°52'00.8"E, 20 Jun 2019, *A.S. Erst, E.Yu. Mitrenina, D.A. Krivenko & O.A. Chernysheva 122* (NS) [Fig. 8F].

Trollius riederianus Fisch. & C.A.Mey.

$2n = 16$, CHN. Russia, Amurskaya Oblast', Zeiskii Raion, Zeya Nature Reserve, Bol'shaya Erakingra River, floodplain, 665 m, 54°03'21.3"N, 126°22'45.0"E, 20 Jun 2020, *T.N. Veklich 002* (NS); Russia, Sakhalinskaya Oblast', Iturup Island, Kasatka Bay, shrub along the stream, 44°58'53.0"N, 147°37'56.1"E, 21 Aug 2019, *O.M. Potseluev 001* (NS) [Fig. 8G].

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IAPT chromosome data 33/6

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* First chromosome count for the species.

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

CACTACEAE

Lepismium cruciforme (Vell.) Miq.

$2n = 22$, CHN. Brazil, Rio de Janeiro, Mangaratiba, 21 Feb 2003, *A. Calvente, T.C. Lopes & E. Saddy 26* (UFRN); Brazil, São Paulo, Santos, 4 Apr 2006, *A. Calvente 195* (SPF).

* *Rhipsalis agudoensis* N.P.Taylor

$2n = 22$, CHN. Brazil, Rio Grande do Sul, Agudo, before 1989, *Horst-Uebelmann 821* (living collection Kew 2003-3061, K).

Rhipsalis cereoides (Backeb. & Voll.) A.Cast.

$2n = 22$, CHN. Brazil, Rio de Janeiro, Niterói, 20 Nov 2004, *A.A.M. Barros, D. Zappi, A. Calvente, B.R. Silva & D.G. Matuano 2302* (RB).

Rhipsalis crispata (Haw.) Pfeiff.

$2n = 22$, CHN. Brazil, São Paulo, Rio Claro, 31 May 2006, *A. Calvente & L.M. Versieux 215* (SPF) [Fig. 9A]; Brazil, São Paulo, Ilhabela, 1 Dec 2007, *A. Calvente & L.M. Versieux 366* (SPF).

* *Rhipsalis cuneata* Britton & Rose

$2n = 44$, CHN. Ecuador, Zamora-Chinchipe, Zamora, 8 Jan 2008, *A. Calvente & L.M. Versieux 381* (SPF).

Rhipsalis elliptica G.Lindb. ex K.Schum.

$2n = 22$, CHN. Brazil, Rio de Janeiro, Rio de Janeiro, 11 Jun 2004, *A. Calvente & L.M. Versieux 96* (RB); Brazil, Bahia, Santa Maria Salto, 10 Feb 2007, *Calvente 320* (RB).

* *Rhipsalis hileiabaiana* (N.P.Taylor & Barthlott) N.Korotkova & Barthlott

$2n = 44$, CHN. Brazil, Bahia, Santa Maria Salto, 10 Feb 2007, *A. Calvente & L.M. Versieux 321* (SPF) [Fig. 9B].

* *Rhipsalis mesembryanthemoides* Haw.

$2n = 22$, CHN. Brazil, Rio de Janeiro, Rio de Janeiro, 2 Aug 2019, *M.F. Freitas & A. Calvente 458*. (RB) [Fig. 9C].

** *Rhipsalis micrantha* (Kunth) DC.

$2n = 22$, CHN. Ecuador, El Oro, Estrada E50, 10 Jan 2008, *A. Calvente & L.M. Versieux 388a* (SPF).

$2n = 44$, CHN. Peru, Cajamarca, Estrada Lambayeque-Moyobamba, 17 Jan 2008, *A. Calvente & L.M. Versieux 395* (SPF) [Fig. 9D].

Rhipsalis nevesarmondii K.Schum.

$2n = 22$, CHN. Brazil, Espírito Santo, Santa Teresa, 27 May 2004, *L.M. Versieux 195* (UFRN).

Rhipsalis paradoxa subsp. *septentrionalis* N.P.Taylor & Barthlott

$2n = 22$, CHN. Brazil, Bahia, Jaguaquara, 6 Feb 2007, *A. Calvente & L.M. Versieux 312* (SPF).

Rhipsalis pentaptera A.Dietr.

$2n = 22$, CHN. Brazil, Rio de Janeiro, Rio de Janeiro, 23 Aug 2005, *A. Calvente & C.H.R. de Paula 121* (SPF).

Rhipsalis pilocarpa Loefgr.

$2n = 22$, CHN. Brazil, Rio de Janeiro, Nova Friburgo, 25 Jan 2004, *A. Calvente 72* (RB).

* *Rhipsalis pulchra* Loefgr.

$2n = 22$, CHN. Brazil, Rio de Janeiro, Nova Friburgo, 18 Feb 2007, *A. Calvente & L.M. Versieux 334* (SPF).

* *Rhipsalis russelli* Britton & Rose

$2n = 22$, CHN. Brazil, Minas Gerais, Conceição do Mato Dentro, 20 Nov 1989, *D.C. Zappi 195* (SPF).

Rhipsalis teres f. *heteroclada* (Britton & Rose) Barthlott & N.P.

Taylor

$2n = 22$, CHN. Brazil, Rio de Janeiro, Rio de Janeiro, 15 May 2004, *A. Calvente & L.M. Versieux 86* (RB) [Fig. 9E].

* *Rhipsalis triangularis* Werderm.

$2n = 22$, CHN. Brazil, Rio de Janeiro, Rio de Janeiro, 15 May 2004, *Calvente 89* (RB) [Fig. 9F,G].

Rhipsalis trigona Pfeiff.

$2n = 22$, CHN. Brazil, São Paulo, São Paulo, 23 Mar 2008, *Calvente 404* (UFRN).

Rhipsalideae comprises the majority of epiphytic and lithophytic cacti inhabiting tropical and subtropical forests (Calvente & al., 2011). The Atlantic Forest in Brazil is the center of diversity of the tribe, with species occurring from coastal to mountainous habitats (Oldfield, 1997). The group is monophyletic, with four genera: *Hattoria* Britton & Rose, *Lepismium* Pfeiff., *Rhipsalis* Gaertn. and *Schlumbergera* Lem. (Calvente & al., 2011; Korotkova & al., 2011). The first three emerged each monophyletic in recent works, while the circumscription of the latter remains controversial; Korotkova & al. (2011) transferred a few species to a fifth genus *Rhipsalidopsis* Britton & Rose, while Calvente & al. (2011) included them in *Schlumbergera*.

Rhipsalis is the largest genus, made up of 40 species (Calvente, 2012) with Neotropical distribution, except for *R. baccifera* (J.S. Muel.) Stearn, which also occurs in Africa and Asia (Rowley, 1978; Calvente, 2012). More than 80% of these species are endemic to Brazil, some with narrow distribution ranges (Barthlott & Taylor, 1995; Calvente & al., 2008). The most frequent chromosome number in the genus as well as in the tribe is $2n = 22$ (Table 2). Chromosome number and size, symmetry and CMA/DAPI, and location and number of ribosomal bands in Rhipsalideae show weak differentiation among species (Moreno & al., 2015; Las Peñas, 2018).

With the aim to contribute to taxonomic and evolutionary research on Rhipsalideae, we here determine the chromosome number of 17 species of *Rhipsalis* (including two distinct populations of *R. crispata*, *R. micrantha* and *R. elliptica*) and one species of *Lepismium*

(two populations) (Table 2); we also present more detailed karyotyping results off our *Rhipsalis* species.

Chromosome preparations followed Guerra & Souza (2002), using root tips of either recently germinated seeds or cultivated plants. Chromosomes were counted in 20 metaphasic cells per species; some were photographed with a regular photomicroscope, using Agfa Pan ISO 25 black and white film.

To obtain the detailed karyotyping results, we measured the chromosomes of 10 cells of *Rhipsalis crispata*, *R. mesembryanthemoides*, *R. teres* and *R. triangularis*, using the mean value of each pair, recognized by size and morphology (according to the nomenclature in Guerra, 1986). We calculated the haploid chromosome length (HCL) from the sum of the sizes of all chromosomal pairs, and the centromeric index (IC) of each pair, dividing the short-arm length by the total length of the respective chromosome and multiplying the result by 100. The IC mean was used to determine the index of karyotype asymmetry (TF%) for each species, according to Huziwara (1962). We detailed

the karyogram of one species with good display and adequate contraction of chromosomes.

The results show $2n = 22$ for 15 of the 17 species of *Rhipsalis* studied, and $2n = 44$ for only *R. cuneata* and *R. hileiabaihana*, and a single population of *R. micrantha* from Peru (Table 2, Fig. 9). Chromosomes were counted for the first time for seven species: *R. agudoensis*, *R. cuneata*, *R. hileiabaihana*, *R. mesembryanthemoides*, *R. pulchra*, *R. russelli* and *R. triangularis*, and for a cytotype of *R. micrantha* (Table 2). For the other 10 species, the numbers obtained agree with previously published records. In total, we verified 28 *Rhipsalis* species with currently known chromosome numbers, representing 70% of the genus (Table 2).

For *Lepismium* (*L. cruciforme*), the results ($2n = 22$) are in agreement with Barthlott (1976) and Rice & al. (2015). It was noted that $2n = 22$ is almost constant for Rhipsalideae, except for *Schlumbergera truncata* (as *Zygocactus truncatus* (Haw.) K.Schum. or *Epiphyllum truncatum* Haw., with $2n = 18$ and $2n = 24$, respectively, in

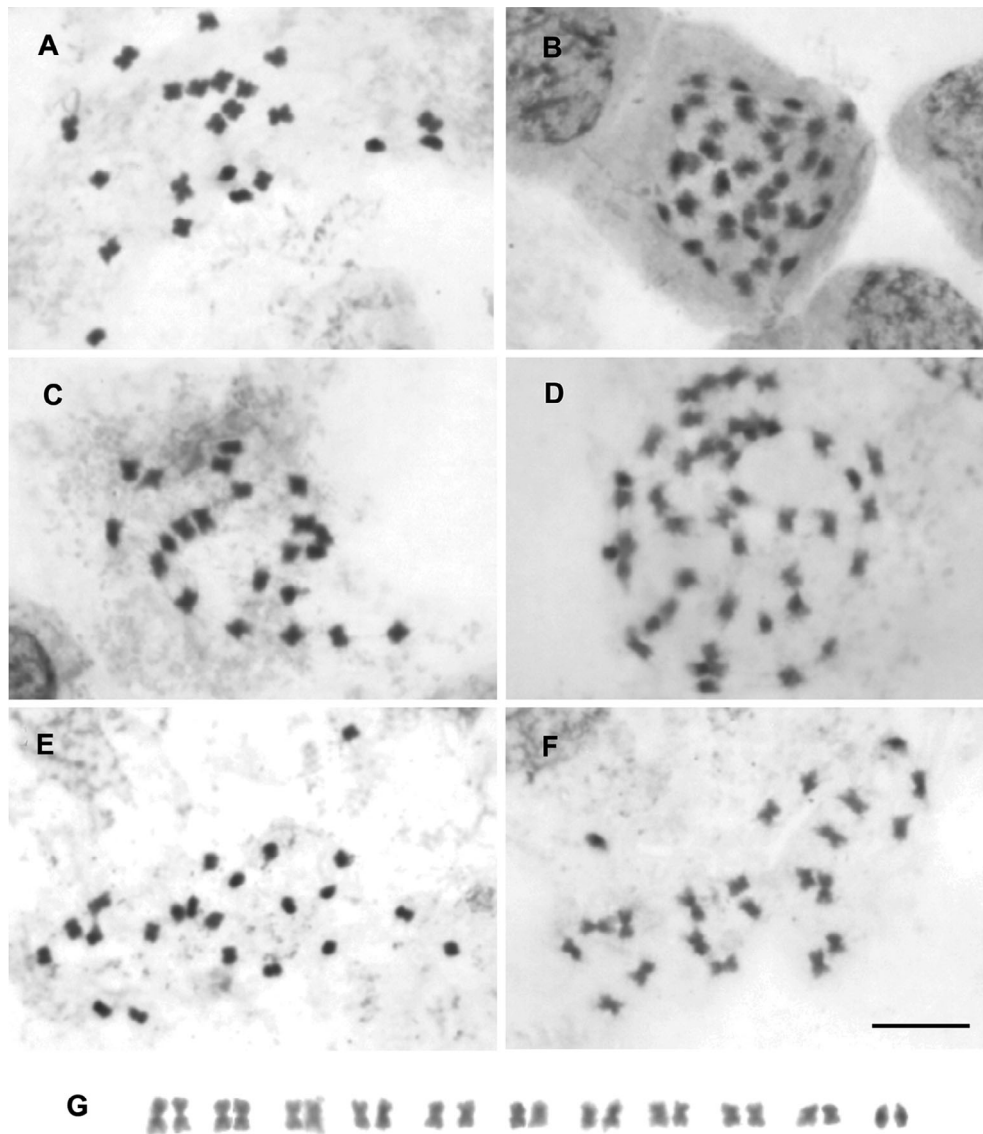


Fig. 9. Mitotic metaphases of *Rhipsalis* species. **A**, *R. crispata* ($2n = 22$); **B**, *R. hileiabaihana* ($2n = 44$); **C**, *R. mesembryanthemoides* ($2n = 22$); **D**, *R. micrantha* ($2n = 44$); **E**, *R. teres* f. *heteroclada* ($2n = 22$); **F**, *R. triangularis* ($2n = 22$); **G**, Cariogram of *R. triangularis*. — Scale bar = 10 μ m (all images on the same scale).

Table 2. Chromosome numbers ($2n$) of *Rhipsalis* species.

Accepted name	Name in the original publication	$2n$	References
<i>R. agudoensis</i> N.P.Taylor*	–	22	This study
<i>R. baccifera</i> (Sol.) Stearn	<i>R. baccifera</i> (Sol.) Stearn	22	Spencer, 1955
	<i>R. cassytha</i> Gaertn.	22	Spencer, 1955
	<i>R. fasciculata</i> (Willd.) Haw.	22	Gadella & al., 1979 in Rice & al., 2015; Barthlott, 1976; Rowley, 1976; Moreno & al., 2015
	<i>R. baccifera</i> (Sol.) Stearn	44	Gadella & al., 1979 in Rice & al., 2015
	<i>R. cassytha</i> Gaertn.	44	Mangenot & Mangenot 1962 in Rice & al., 2015; Barthlott, 1976; Barthlott & Taylor, 1995; Rowley, 1978
<i>R. baccifera</i> (Sol.) Stearn	88	Rowley, 1978	
<i>R. cereoides</i> (Backeb. & Voll) A.Cast.	<i>R. cereoides</i> (Backeb. & Voll) A.Cast.	22	Barthlott, 1976; this study
<i>R. cereuscula</i> Haw.	<i>R. cereuscula</i> Haw.	22	Barthlott, 1976; Moreno & al., 2015
<i>R. clavata</i> F.A.C.Weber	<i>R. clavata</i> F.A.C.Weber	22	Barthlott, 1976
<i>R. crispata</i> (Haw.) Pfeiff.	<i>R. crispata</i> (Haw.) Pfeiff.	22	Barthlott, 1976; Gadella & al. 1979 in Rice & al., 2015; this study
<i>R. cuneata</i> Britton & Rose*	–	44	This study
<i>R. elliptica</i> G.Lindb. ex K.Schum.	<i>R. elliptica</i> G.Lindb. ex K.Schum.	22	Gadella & al. 1979 in Rice & al., 2015; this study
<i>R. floccosa</i> subsp. <i>hohenauensis</i> (F.Ritter) Barthlott & N.P.Taylor	<i>R. floccosa</i> var. <i>hohenauensis</i> (F.Ritter) Barthlott & N.P.Taylor	22	Moreno & al., 2015
<i>R. floccosa</i> subsp. <i>pittieri</i> (Britton & Rose) Barthlott & N.P.Taylor	<i>R. pittieri</i> Britton & Rose	14	Pankin, 1999 in Rice & al., 2015
	<i>R. floccosa</i> subsp. <i>pittieri</i> (Britton & Rose) Barthlott & N.P.Taylor	22	Pankin, 2005 in Rice & al., 2015
<i>R. floccosa</i> subsp. <i>pulvinigera</i> (G.Lindb.) Barthlott & N.P.Taylor	<i>R. gibberula</i> F.A.C.Weber	22	Gadella & al., 1979 in Rice & al., 2015
<i>R. floccosa</i> subsp. <i>tucumanensis</i> (F.A.C. Weber) Barthlott & N.P. Taylor	<i>R. tucumanensis</i> F.A.C.Weber	22	Gadella & al., 1979 in Rice & al., 2015; Moreno & al., 2015
<i>R. goebeliana</i> Backeb.	<i>R. goebeliana</i> Backeb.	22	Barthlott, 1976
<i>R. grandiflora</i> Haw.	<i>R. grandiflora</i> Haw.	22	Barthlott, 1976
	<i>R. hadrosoma</i> G.Lindb.	22	Gadella & al., 1979 in Rice & al., 2015
<i>R. hileabaiana</i> (N.P. Taylor & Barthlott) N.Korotkova & Barthlott*	–	44	This study
<i>R. mesembryanthemoides</i> Haw.*	–	22	This study
<i>R. mesembryanthoides</i> Haw.**	<i>R. mesembryanthoides</i> Haw.	22	Beard, 1937; Takagi, 1938 in Rice & al., 2015

(Continues)

Table 2. Continued.

Accepted name	Name in the original publication	2n	References
<i>R. micrantha</i> (Kunth) DC.*	–	22	This study
	–	44	This study
<i>R. neves-armondii</i> K.Schum.	<i>R. megalantha</i> Loefgr.	22	Barthlott, 1976; Gadella & al.; 1979 in Rice & al., 2015; this study
<i>R. oblonga</i> Loefgr.	<i>R. oblonga</i> Loefgr.	22	Gadella & al., 1979 in Rice & al., 2015
<i>R. pachyptera</i> Pfeiff.	<i>R. pachyptera</i> Pfeiff.	22	Gadella & al. 1979 in Rice & al., 2015
<i>R. paradoxa</i> (Salm-Dyck) Salm-Dyck	<i>R. paradoxa</i> (Salm-Dyck) Salm-Dyck	22	Barthlott, 1976; Gadella & al., 1979 in Rice & al., 2015; this study
<i>R. pentaptera</i> Pfeiff. ex A.Dietr.	<i>R. pentaptera</i> Pfeiff. ex A.Dietr.	22	Ross 1981; this study
<i>R. pilocarpa</i> Loefgr.	<i>R. pilocarpa</i> Loefgr.	22	Barthlott, 1976; Ross, 1981; this study
<i>R. pulchra</i> Loefgr.*	–	22	This study
<i>R. rigida</i> Loefgr.**	<i>R. rigida</i> Loefgr.	22	Gadella & al., 1979 in Rice & al., 2015
<i>R. robusta</i> G.Lindb.**	<i>R. robusta</i> G.Lindb.	22	Barthlott, 1976
<i>R. russellii</i> Britton & Rose*	–	22	This study
<i>R. teres</i> (Vell.) Steud.	<i>R. capilliformis</i> F.A.C.Weber	22	Barthlott, 1976
	<i>R. heteroclada</i> Britton & Rose	22	Barthlott, 1976
	<i>R. teres</i> (Vell.) Steud.	22	This study
<i>R. triangularis</i> Werderm.*	–	22	This study
<i>R. trigona</i> Pfeiff.	<i>R. trigona</i> Pfeiff.	22	Gadella & al., 1979 in Rice & al., 2015; this study

* First count; ** unresolved status

Rice & al., 2015). Our results confirm $x = 11$ for *Rhipsalis* and *Lepismium* (Pinkava & al., 1985; Las Penãs & al., 2009), which is in agreement with the basic chromosome number suggested for Cactaceae (Pinkava & al., 1985, 1992; Cota & Wallace, 1995; Bandyopadhyay & Sharma, 2000; Las Penãs & al., 2009).

Polyploid *Rhipsalis* species correspond to 7% of the species analyzed to date (Table 2). Polyploidy was previously known only to occur in *R. baccifera* (Table 2); our results indicate polyploid individuals in *R. cuneata*, *R. hileiabaiana* and *R. micrantha*. Although we found either diploid and tetraploid individuals in *R. micrantha*, it is still to be investigated if *R. cuneata* and *R. hileiabaiana* also show variance in ploidy levels, as we only analyzed one sample of each species. Even though they all belong to the *R.* subg. *Rhipsalis*, the fact we may find interspecific variance in ploidy levels and that all these species appear in different clades (Calvente & al., 2011), leads us to believe that polyploidy emerged independently in *Rhipsalis*.

Three levels of ploidy occur in *Rhipsalis baccifera*, the only species with disjunct distribution in Neo- and Paleotropical regions. The diploid specimens ($2n = 22$) occur in Brazil, Bolivia and Paraguay; the tetraploid ones ($2n = 44$) in Mexico, Central America, the Caribbean and central Africa; and tetraploid ($2n = 44$) and octoploid ($2n = 88$) specimens occur in Madagascar. Cota-Sánchez & Bomfim-Patricio

(2010) analyzed different morphological characters throughout the distribution of this species and highlighted the importance of polyploidy in the colonization of new habitats and irradiation from South America to the North of the Americas and the paleotropical region. These authors proposed that the ancestral diploid condition ($2n = 22$) occurs close to the center of the species' place of origin (South America), with smaller seeds than the other cytotypes.

Polyploidy is a significant evolutionary mechanism in the differentiation of populations of the same species and in subsequent possible speciation events. Although less frequent in Rhipsalideae, it is important in Cactaceae. Among the 551 taxa Pinkava & al. (1985) analyzed, 154 (27.9%) showed polyploidy, particularly in *Opuntia* Mill., with $2n = 22, 33, 44, 55$ and 66 . On the other side, aneuploidy/disploidy in Cactaceae is rarely mentioned and maybe associated with chromosome count errors (Pinkava & McLeod, 1971), as in $2n = 14$ for *Rhipsalis floccosa* subsp. *pittieri* (Britton & Rose) Barthlott & N.P.Taylor (Table 2).

The chromosomes of the Rhipsalideae species sampled are mainly small, varying from 1.0 to 4.0 μm among species (Fig. 9). The measurements taken for the four species fit within this interval (Table 3), with differences in the range of variance. The longest haploid length (HCL) measured was that of *R. triangularis* (28.7 μm ,

Table 3. Chromosome number ($2n$), range of chromosome length, total haploid chromosome length (HCL), karyotype formula (KF) and asymmetry index (TF%) of the *Rhipsalis* species studied.

Species	$2n$	Range of length (μm)	HCL (μm)	KF	TF%
<i>R. crispata</i>	22	1.8–2.4	20.1	11m	44.1
<i>R. mesembryanthemoides</i>	22	1.7–2.6	22.6	11m	44.1
<i>R. teres</i>	22	1.2–2.1	16.9	10m + 1sm	47.3
<i>R. triangularis</i>	22	2.4–3.2	28.7	10m + 1sm	44.0

m, metacentric; sm, submetacentric.

with chromosomes varying from 2.4 to 3.2 μm), while the shortest (16.9 μm) was that of *R. teres* (chromosomes varying from 1.2 to 2.1 μm , Table 3). The results of chromosome size variance are similar to those observed by Moreno & al. (2015) and Las Peñas (2018) for *Rhipsalis* and *Lepismium*, and for several other species of Cactaceae studied by Las Peñas & al. (2009) and Castro & al. (2013, 2016).

The chromosomes in *Rhipsalis* are mostly metacentric (Fig. 9, Table 3). In *R. crispata* and *R. mesembryanthemoides*, the chromosomes are exclusively metacentric, while *R. teres* and *R. triangularis* also feature a submetacentric pair (Table 3). Moreno & al. (2015) also found metacentric chromosomes in their study, while Las Peñas (2018) mentioned a submetacentric pair in *R. lumbricoides*. The karyotypes are symmetric as in other cacti (Las Peñas & al., 2009), and the species with the highest symmetry value was *R. teres* (TF% = 47.3). Moreno & al. (2015) and Las Peñas (2018) used other symmetry indexes (A1 – intrachromosomal and A2 – interchromosomal, from Romero Zarco, 1986), but also reported symmetric karyotypes for *Rhipsalis* and *Lepismium*.

We observed terminal secondary constriction in at least one or two chromosomes in a few *Rhipsalis* species (Fig. 9), mainly in metaphase cells with moderate chromosome contraction. We could not distinguish whether the secondary constrictions (nucleolus organizer region – NOR, with ribosomal gene DNAr 18S-5.8S-26S) belonged to a single pair or two distinct pairs. Using the FISH technique, Moreno & al. (2015) mapped the distribution of this ribosomal gene in some *Rhipsalis* and *Lepismium* species and observed NORs in the terminal positions of only one chromosome pair, except for one species, in which they observed two pairs.

Overall, we observed conserved chromosome numbers for Rhipsalideae ($2n = 22$) and a few cases of polyploidy. The karyotypes are symmetric and very similar, with chromosomes that are mostly metacentric and with low variation in size. Nevertheless, the knowledge about the evolution of karyotypes in the group can be improved with additional studies including more species and specimens and a wider array of techniques, such as chromosome banding and FISH.

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IAPT chromosome data 33/7

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- * First chromosome count for the species.
- First gametic chromosome count for the species.
- ▼ New cytotype for the species.
- First meiotic behaviour study for the species.

Methods are described in Daviña & Fernández (1989) and Daviña (2001).

AMARYLLIDACEAE

The Amaryllidaceae family comprises 860 species in 59 genera with mainly tropical distribution (Meerow & Snijman, 1998). Within this family, the South American tribe Hippeastreae includes *Habranthus* Herb., commonly named “rain lilies”. This genus comprises approximately 40–60 species, distributed from northern Patagonia, Argentina (South America) to Mexico, with one species most probably introduced into Texas (United States) (Holmes & Wells, 1980; Arroyo, 1990; Meerow & Snijman, 1998; Howard, 2001; Amaral, 2011). *Habranthus* is a taxon with intergeneric and intraspecific taxonomic

difficulties (García & al., 2019). In this study, the populations of four *Habranthus* species from Argentina were investigated.

* ● ■ *Habranthus andalgalensis* Ravenna

$n = 6\text{II}$, $2n = 2x = 12$, CHN. Argentina, Misiones, Candelaria Department, Campo San Juan, 27°24'S, 55°40'W, 9 Apr 2015, *A.I. Honfi 1921* (MNES) [Figs. 10A, 11B,C, 12A].

All individuals in the population of *H. andalgalensis* from Misiones had a diploid complement with $2n = 2x = 12$ chromosomes and a haploid karyotype formula of $4m + 2sm$. Microsatellites were observed at terminal position in the long arm of pairs 2 and 6. The meiotic behavior in all studied pollen mother cells (PMCs) was highly regular, with six bivalents at metaphase I and normal segregation in anaphase I.

● ▼ *Habranthus chacoensis* Ravenna

$2n = 2x = 12 + B$, $2n = 2x = 12 + 2B$, $2n = 2x = 12 + 3B$, CHN. Argentina, Chaco, 1° de Mayo Department, Colonia Benítez, 27°19'S, 58°59'W, 15 Jan 2013, *J.R. Daviña 661* (MNES) [Figs. 10B,C].

$n = 6$, $2n = 2x = 12$. Argentina, Corrientes, San Luis del Palmar Department, 27°27'S, 58°33'W, 4 Feb 2015, *A.I. Honfi 2246* (MNES) [Figs. 11A, 12B].

Both accessions of *H. chacoensis* had a diploid chromosomal complement $2n = 2x = 12$ and a karyotype formula of $3m + 2sm + 1st$. A secondary constriction in the short arm of the chromosome pair 4 (sm) was observed. One accession had individuals with $2n = 2x = 12 + Bs$ (*Daviña 661*) in polymorphic condition. In addition, pollen grain mitosis was observed, confirming the haploid number $n = 6$. These counts agree with previous reports (Daviña & Honfi, 2018).

Habranthus pedunculatus Herb.

$2n = 2x = 14$, CHN. Argentina, Misiones, Capital Department, Parada Leis, 27°36'S, 55°51'W, 5 Nov 2014, *J.R. Daviña 678* (MNES) [Figs. 10E, 12C]; Argentina, Misiones, Capital Department, Posadas, 27°25'S, 55°55'W, 14 Feb 2017, *A.C. Gianini Aquino 17* (MNES); Argentina, Misiones, Capital Department, Posadas, 27°25'S, 55°55'W, 30 Nov 2018, *A.C. Gianini Aquino 50* (MNES); Argentina, Misiones, Candelaria Department, Campo San Juan, 27°24'S, 55°40'W, 9 Apr 2015, *A.I. Honfi 1919* (MNES); Argentina, Corrientes, Mercedes Department, Prov. Rute 123, Arroyo Miriñay, 29°33'S, 57°29'W, 15 Mar 2010, *J.R. Daviña 622* (MNES); Argentina, Corrientes, Mercedes Department, Prov. Route 123, Arroyo Miriñay, 29°33'S, 57°29'W, 7 Dec 2015, *A.I. Honfi 2120B* (MNES); Argentina, Corrientes, Capital Department, Corrientes, 27°27'S, 58°49'W, 16 Mar 2016, *A.C. Gianini Aquino 3* (MNES); Argentina, Corrientes, Saladas Department, Prov. Route 118, 10 km from Saladas, 28°21'S, 58°24'W, 21 Feb 2015, *A.I. Honfi 1738* (MNES); Argentina, Corrientes, Nat. Route 14, 65 km from Paso de la patria, 29°56'S, 57°38'W, 7 Dec 2015, *A.I. Honfi 2118B* (MNES); Argentina, Corrientes, San Luis del Palmar Department, Prov. Route 5, 10 km from San Luis del Palmar, 27°29'S, 58°41'W, 4 Feb 2017, *A.I. Honfi 2244* (MNES); Argentina, Santa Fe, Vera Department, Vera, 29°27'S, 60°12'W, 24 Apr 2018, *A.I. Honfi 2335* (MNES).

In all populations of *H. pedunculatus*, a diploid chromosome complement with $2n = 2x = 14$ and karyotype formula $1m + 3sm + 3st$ was observed. Microsatellites were observed in the long arm of pair 6 (st) at terminal position. Our results agree with previous counts (Flory, 1948; Flory & Flagg, 1958; Naranjo, 1974; Daviña & Honfi 2018).

● ■ *Habranthus robustus* Herb.

$2n = 2x = 12$, CHN. Argentina, Misiones, Candelaria Department, Bonpland, 27°27'S, 55°25'W, 7 Dec 2010, *J.R. Daviña 641*

(MNES); Argentina, Misiones, 25 de Mayo Department, 25 de Mayo, 27°22'S, 54°45'W, 30 Dec 2018, *A.C. Gianini Aquino 51* (MNES); Argentina, Misiones, Caingúas Department, Aristóbulo del Valle, 27°08'S, 54°54'W, 30 Dec 2018, *A.C. Gianini Aquino 52* (MNES); Argentina, Misiones, Oberá Department, Oberá, 27°29'S, 55°09'W, 30 Dec 2018, *A.C. Gianini Aquino 53* (MNES); Argentina, Misiones, Iguazú Department, Puerto Iguazú, 25°36'S, 54°34'W, 6 Jan 2020, *A.C. Gianini Aquino 55* (MNES); Argentina, Misiones, San Ignacio Department, Teyú Cuaré, 27°16'S, 55°33'W, 9 Dec 2007, *A.I. Honfi*

1338 (MNES); Argentina, Misiones, Candelaria Department, Campo San Juan, 27°25'S, 55°37'W, 1 Apr 2015, *A.I. Honfi 2158* (MNES).

$n = 6\text{II}$, $2n = 2x = 12$, Argentina, Misiones, Leandro N. Alem Department, Leandro N. Alem, 27°23'S, 55°19'W, 26 Nov 2016, *A.C. Gianini Aquino 6* (MNES) [Figs. 10D, 11D–F, 12D].

All accessions of *H. robustus* showed $2n = 2x = 12$ chromosomes and a haploid karyotype formula of $3m + 2sm + 1st$. A secondary constriction was observed in the short arm of chromosome pair 5 (sm). The meiotic behavior in PMCs at metaphase I was regular, with

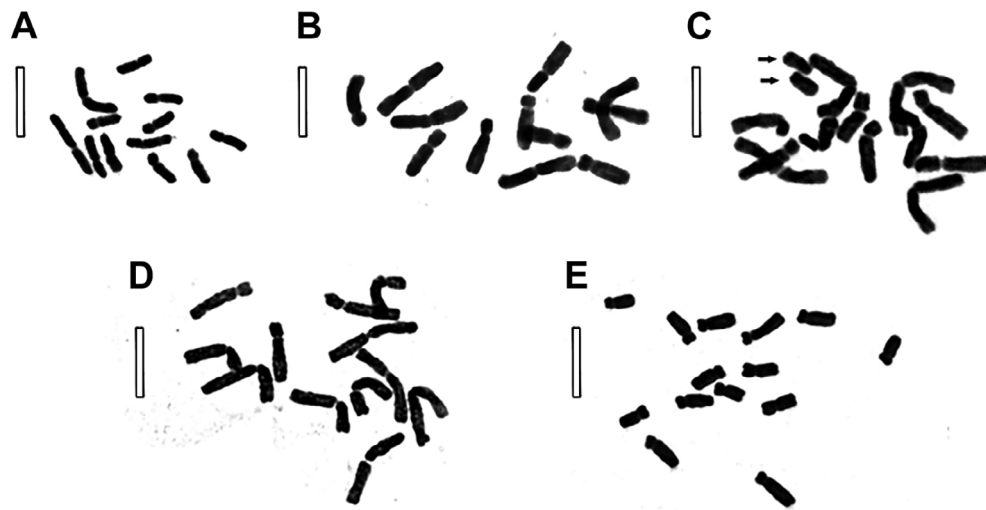


Fig. 10. Mitotic chromosomes with conventional staining; mitotic metaphase. **A**, *Habranthus andalgalensis*, $2n = 12$ (*A.I. Honfi 1921*); **B**, *H. chacoensis*, $2n = 12$ (*J.R. Daviña 661*); **C**, *H. chacoensis*, $2n = 12 + 2B$ indicated by arrows (*J.R. Daviña 661*); **D**, *H. robustus*, $2n = 12$ (*A.C. Gianini Aquino 6*); **E**, *H. pedunculatus*, $2n = 14$ (*J.R. Daviña 678*). — Scale bars = 10 μm .

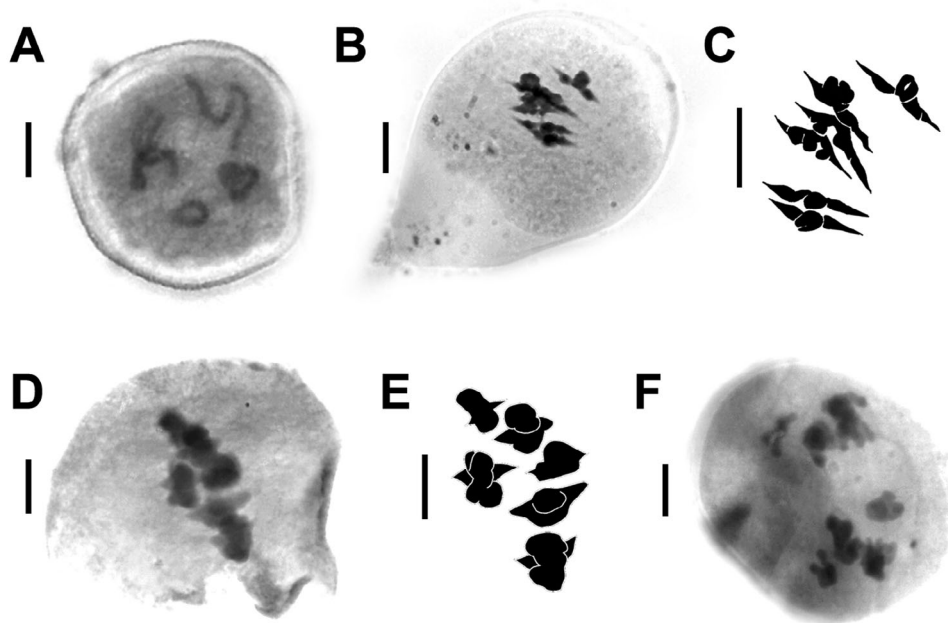


Fig. 11. Meiotic chromosomes and haploid numbers. **A**, *Habranthus chacoensis*, $n = 6$, mitosis in pollen grain (*A.I. Honfi 2246*); **B**, *H. andalgalensis*, PMC at metaphase I with 6 bivalents (*A.I. Honfi 1921*); **C**, *H. andalgalensis*, interpretive drawing of **C**; **D**, *H. robustus*, pollen mother cell at metaphase I, with 6II (*A.C. Gianini Aquino 6*); **E**, *H. robustus*, interpretive drawing of **D**; **F**, *H. robustus*, normal segregation in anaphase I (*A.C. Gianini Aquino 6*). — Scale bars = 10 μm .

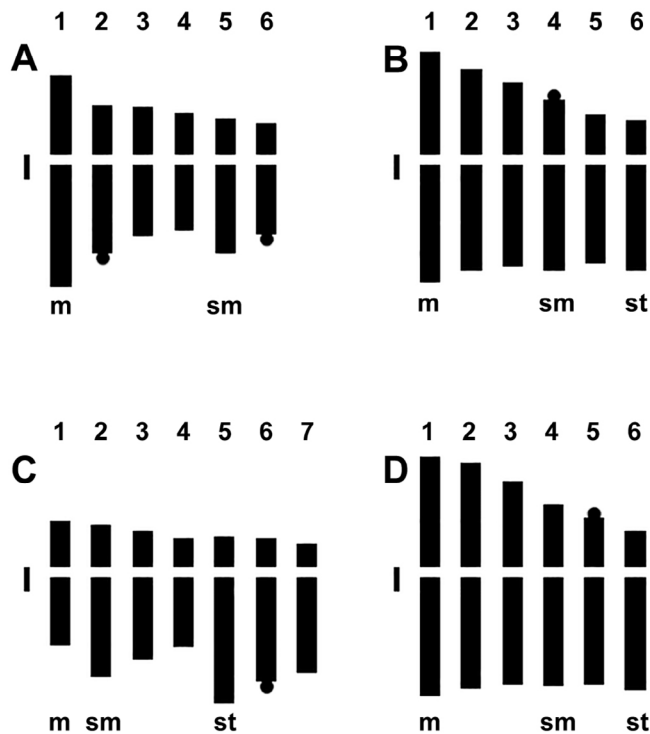


Fig. 12. Idiograms. **A**, *Habranthus andalgalensis*, $2n = 12$, $4m + 2sm$; **B**, *H. chacoensis*, $2n = 12$, $3m + 2sm + 1st$; **C**, *H. pedunculatus*, $2n = 14$, $1m + 3sm + 3st$; **D**, *H. robustus*, $2n = 12$, $3m + 2sm + 1st$. — Scale bars = 1 μ m.

formation of six bivalents (II) and normal segregation in anaphase I. Previous reports showed that *H. robustus* have several chromosome numbers, $2n = 12$ (Flory, 1938; Sato, 1938, 1942; Cage, 1969; Saito & Sato, 1972; Nandi, 1973; Felix & al., 2011), $2n = 24$ (Flory, 1948) and $2n = 48$ (Mookerjea, 1955; Nandi, 1973).

This is the first report of meiotic behavior in *H. andalgalensis* ($n = 6$) and *H. robustus* ($n = 6$). The haploid number of *H. chacoensis* ($n = 6$) was confirmed.

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IAPT chromosome data 33/8

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Chromosomes counted by M. Lomonosova; DNA ploidy levels estimated by T. An’kova. Chromosome number and DNA ploidy level determined in cultivated plants grown from seeds sampled in the field.

The absolute nuclear DNA amount was assessed by flow cytometry using a Cy Flow Space cytometer (Sysmex Partec, Görlitz,

Germany) equipped with a green laser. The sample preparation and FCM procedure followed that of Doležel & al. (2007).

- * First chromosome count for the species
- ** First chromosome count from a given country.

AMARANTHACEAE

** *Atriplex micrantha* C.A.Mey.

$2n = 4x = 36$, CHN. Uzbekistan, Bukhara Region, along the road Bukhara–Gasli, 40°06'57"N, 63°58'09"E, 23 Oct 2019, *Kh. Esanov s.n.* (NS) [Fig. 13A].

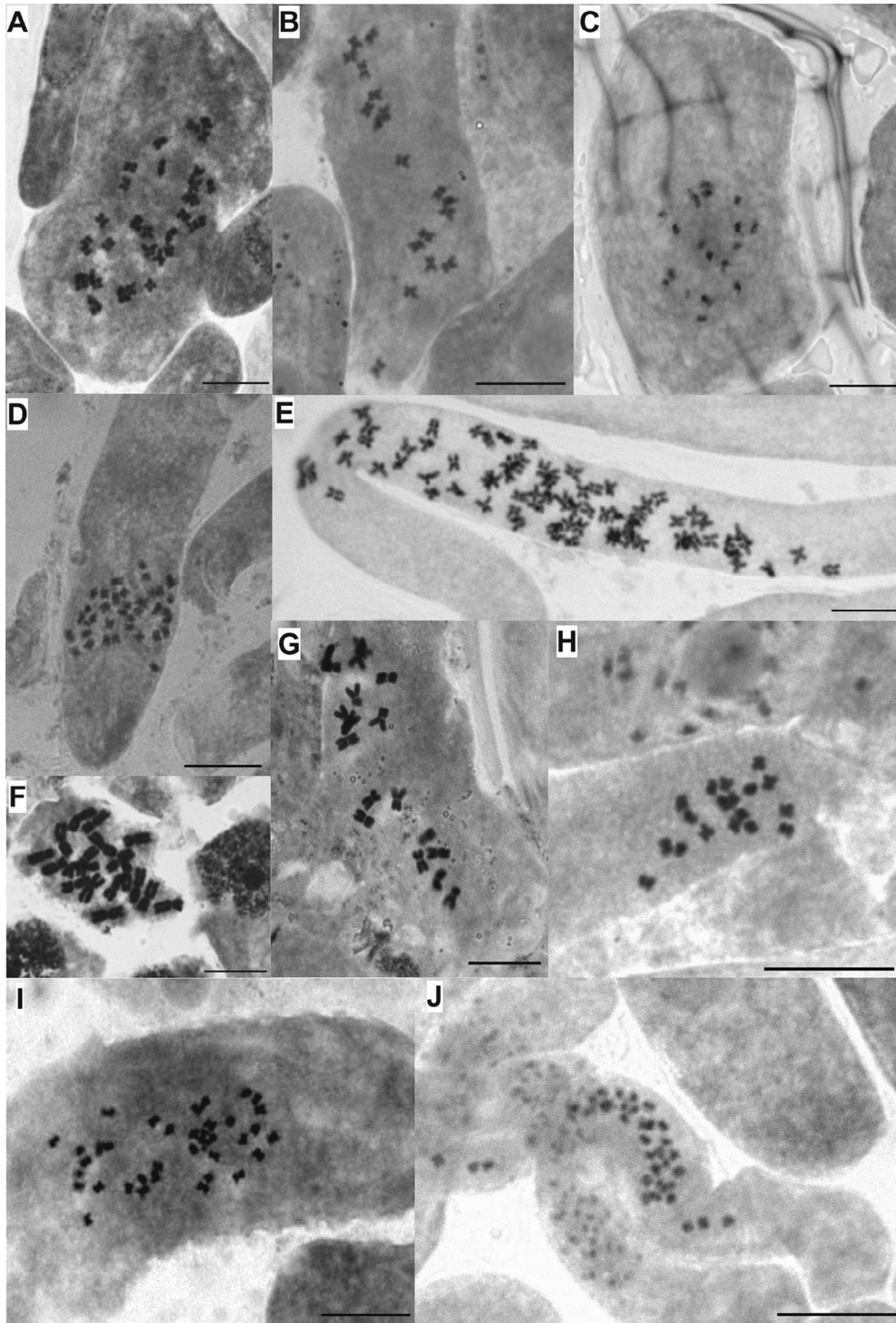


Fig. 13. Mitotic metaphase. **A**, *Atriplex micrantha*, $2n = 36$; **B**, *Atriplex tatarica*, $2n = 18$; **C**, *Climacoptera amblyostegia*, $2n = 18$; **D**, *Chenopodium betaceum*, $2n = 36$; **E**, *Girgensonia, diptera*, $2n = 72$; **F**, *Suaeda altissima*, $2n = 18$; **G**, *Suaeda arcuata*, $2n = 18$; **H**, *Suaeda heterophylla*, $2n = 18$; **I**, *Suaeda salsa*, $2n = 36$; **J**, *Suaeda spicata*, $2n = 36$. — Scale bars = 10 μ m.

$2n \approx 4x \approx 36$, $2C = 3.74\text{--}4.12$ pg, FCM. Uzbekistan, Bukhara Region, along the road Bukhara–Gasli, $40^{\circ}06'57''\text{N}$, $63^{\circ}58'09''\text{E}$, 23 Oct 2019, *Kh. Esanov s.n.* (NS).

** *Atriplex tatarica* L.

$2n = 2x = 18$, CHN. Uzbekistan, Bukhara Region, vicinity of Bukhara city, $40^{\circ}03'28''\text{N}$, $64^{\circ}07'08''\text{E}$, 23 Oct 2019, *Kh. Esanov s.n.* (NS) [Fig. 13B].

$2n \approx 2x \approx 18$, $2C = 1.25\text{--}1.27$ pg, FCM. Uzbekistan, Bukhara Region, vicinity of Bukhara city, $40^{\circ}03'28''\text{N}$, $64^{\circ}07'08''\text{E}$, 23 Oct 2019, *Kh. Esanov s.n.* (NS).

** *Chenopodium betaceum* Andr.

$2n = 4x = 36$, CHN. Uzbekistan, Bukhara Region, along the road from Bukhara to Gasli, $40^{\circ}08'02''\text{N}$, $63^{\circ}53'43''\text{E}$, 23 Oct 2019, *Kh. Esanov s.n.* (NS) [Fig. 13D].

* *Climacoptera amblyostegia* Botsch.

$2n = 2x = 18$, CHN. Uzbekistan, Namangan Region, Chust District, vicinity of Baimak village, $41^{\circ}04'12''\text{N}$, $71^{\circ}22'49''\text{E}$, 15 Nov 2019, *O. Turginov s.n.* (NS) [Fig. 13C].

* *Girgenosia diptera* Bunge

$2n = 8x = 72$, CHN. Uzbekistan, Namangan Region, Chust District, vicinity of Baimak village, $41^{\circ}04'13''\text{N}$, $71^{\circ}22'45''\text{E}$, 15 Nov 2019, *O. Turginov s.n.* (NS) [Fig. 13E].

Suaeda altissima (L.) Pall.

$2n = 2x = 18$, CHN. Republic of Armenia, Armavir Province, Echmiadzin, $40^{\circ}10'\text{N}$, $44^{\circ}18'\text{E}$, 18 Oct 2014, *J. Akopian s.n.* (NS) [Fig. 13F].

This count confirms a previous report from Armenia (Lomonosova & al., 2007).

Suaeda arcuata Bunge

$2n = 2x = 18$, CHN. Uzbekistan, Bukhara Region, Shekhoncha village, abandoned places, $40^{\circ}03'58''\text{N}$, $64^{\circ}08'07''\text{E}$, 23 Oct 2019, *Kh. Esanov s.n.* (NS) [Fig. 13G].

The same chromosome number was reported from Uzbekistan by Lomonosova & al. (2007).

** *Suaeda heterophylla* (Kar. & Kir.) Bunge

$2n = 2x = 18$, CHN. Republic of Armenia, Ararat Province, salt marshes in the vicinity of Ararat town, $39^{\circ}49'56''\text{N}$, $44^{\circ}43'17''\text{E}$, 9 Sep 2017, *J. Akopian 1* (ERE, NS) [Fig. 13H].

Suaeda salsa (L.) Pall.

$2n = 4x = 36$, CHN. Republic of Armenia, Ararat Province, salt marshes in the vicinity of Ararat town, $39^{\circ}49'56''\text{N}$, $44^{\circ}43'17''\text{E}$, 9 Sep 2017, *J. Akopian 2* (ERE, NS) [Fig. 13I].

This count confirms a previous report from Armenia (Lomonosova & al., 2007).

** *Suaeda spicata* (Willd.) Moq.

$2n = 4x = 36$, CHN. Tunisia, Kheniss (Monastir Governorate), salt marshes, alt. 1–2 m a.s.l., $35^{\circ}43'\text{N}$, $10^{\circ}49'\text{W}$, 10 Nov 2017, *R. El Mokni s.n.* (NS) [Fig. 13J].

This is the second chromosome count for *S. spicata*. The same chromosome number was published earlier from Spain (Pedrol & Castroviejo, 1988).

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IAPT chromosome data 33/9

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* First chromosome count for the species.

● New chromosome report for the species.

PTERIDACEAE/CHEILANTHOIDEAE

● *Adiantopsis chlorophylla* (Sw.) Fée

$2n = 60$, $x = 30$, CHN. Argentina, Jujuy, Calilegua, $24^{\circ}19'08.1''\text{S}$, $64^{\circ}31'01''\text{W}$, 24 Jan 2019, *Morero & al. 511* (CORD) [Fig. 14A].

This new chromosome record agrees with a previous gametophytic count ($n = 30$) from Paraguay, under *Cheilanthes chlorophylla* Sw. (Smith & Foster, 1984).

● *Adiantopsis radiata* (L.) Fée

$2n = 60$, $x = 30$, CHN. Argentina, Misiones, $27^{\circ}20'01''\text{S}$, $55^{\circ}25'10''\text{W}$, 24 Mar 2019, *Morero & Meza Torres 518* (CORD) [Fig. 14B].

This chromosome count agrees with two previous records from Paraguay (Smith & Foster, 1984) and Trinidad (Walker, 1985).

* *Adiantopsis tweediana* (Hook.) Link-Pérez & Hickey

$2n = 60$, $x = 30$, CHN. Argentina, Córdoba, Capilla del Monte, $30^{\circ}51'25''\text{S}$, $64^{\circ}32'19''\text{W}$, 14 Feb 2020, *Morero 521* (CORD) [Fig. 14C].

* *Argyrochosma flava* (Hook.) M.Kessler & A.R.Sm.

$2n = 54$, $x = 27$, CHN. Argentina, Córdoba, Capilla del Monte, $30^{\circ}51'05.33''\text{S}$, $64^{\circ}32'21.10''\text{W}$, 4 Mar 2015, *Morero 435* (CORD) [Fig. 14D].

Evidence based on spore analyses led Sigel & al. (2011) to infer that *A. flava* is an apomictic species, while Ponce & Scataglini (2018) confirmed both sexual and asexual reproduction.

● *Argyrochosma nivea* (Poir.) Windham var. *nivea*

$2n = 54$, $x = 27$, CHN. Argentina, Córdoba, La Paisanita, $31^{\circ}43'03.04''\text{S}$, $64^{\circ}28'24.56''\text{W}$, 18 Apr 2015, *Morero 450* (CORD) [Fig. 14E].

Our count differs from a previous report of $2n = 81$ based on a specimen from Peru (Sigel & al., 2011).

● *Argyrosma tenera* (Gillies ex Hook.) M.Kessler & A.R.Sm.

$2n = 54$, $x = 27$, CHN. Argentina, Córdoba, Río Ceballos, 31°08' 43"S, 64°21'22"W, 25 Nov 2019, *Morero 517* (CORD) [Fig. 14F].

For this species, two sporophytic counts were documented: $2n = 54$ (as also found here), and $2n = 81$, from an Argentinean specimen (Hernández & al., 2015). Diploids and triploids were estimated by correlation with spore size by Sigel & al. (2011).

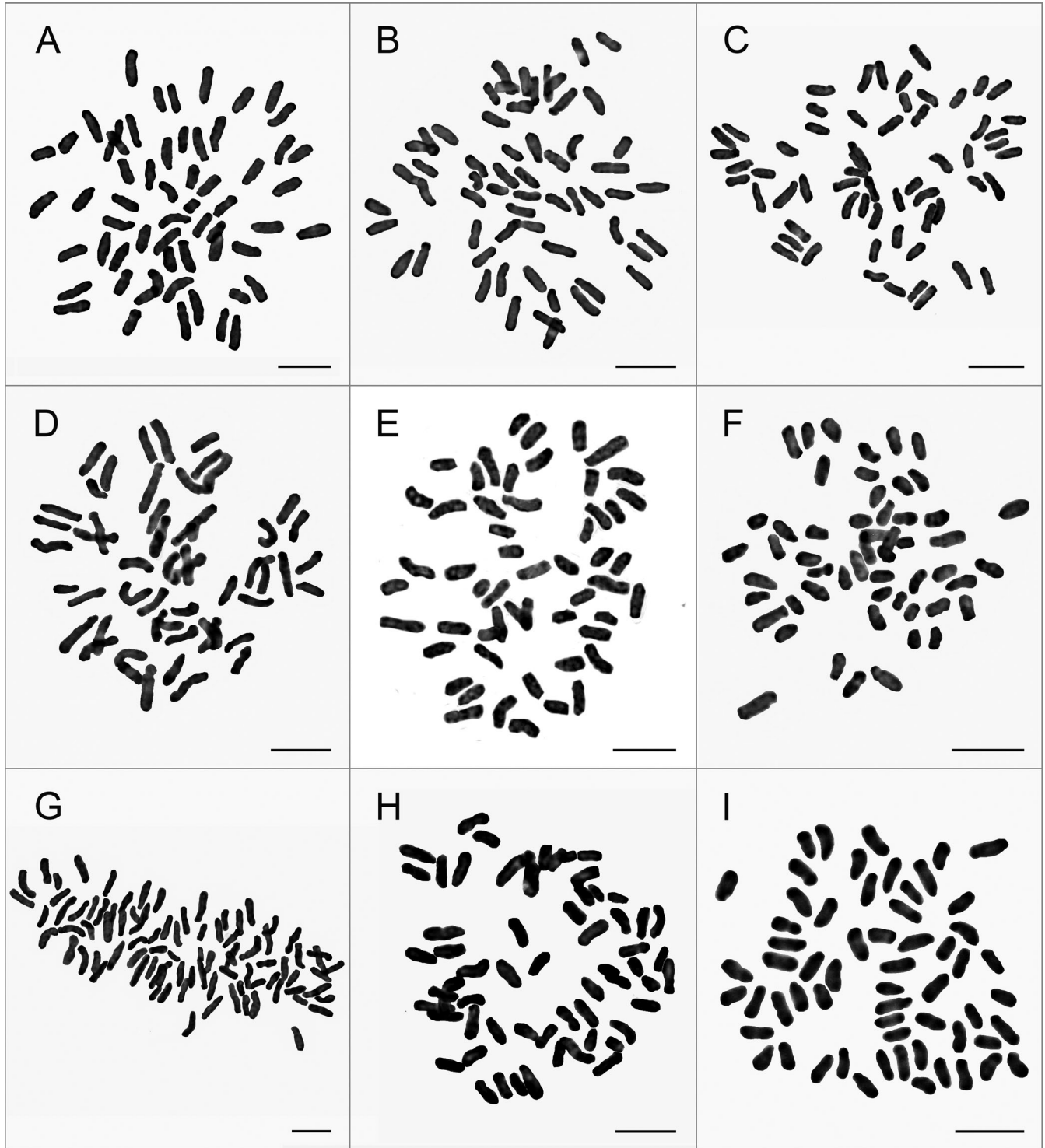


Fig. 14. Photomicrographs of mitotic metaphases. **A**, *Adiantopsis chlorophylla*; **B**, *Adiantopsis radiata*; **C**, *Adiantopsis tweediana*; **D**, *Argyrosma flava*; **E**, *Argyrosma nivea* var. *nivea*; **F**, *Argyrosma tenera*; **G**, *Astrolepis sinuata*; **H**, *Cheilanthes buchtienii*; **I**, *Cheilanthes glauca*. — Scale bars = 5 μ m.

● *Astrolepis sinuata* (Lag. ex Sw.) D.M.Benham & Windham
 $2n = 87$, $x = 29$, CHN. Argentina, Jujuy, between El Fuerte and
 San Pedro de Jujuy, 24° 19'08.1"S, 64° 31'01"W, 23 Jan 2019, *Morero*
 & *al.* 509 (CORD) [Fig. 14G].

Astrolepis sinuata has been reported as sexual diploid ($n = 29$) as
 well as an apomictic triploid ($2n = 87$) (Benham & Windham, 1992;
 and references therein). Our result is in agreement with the latter
 number.

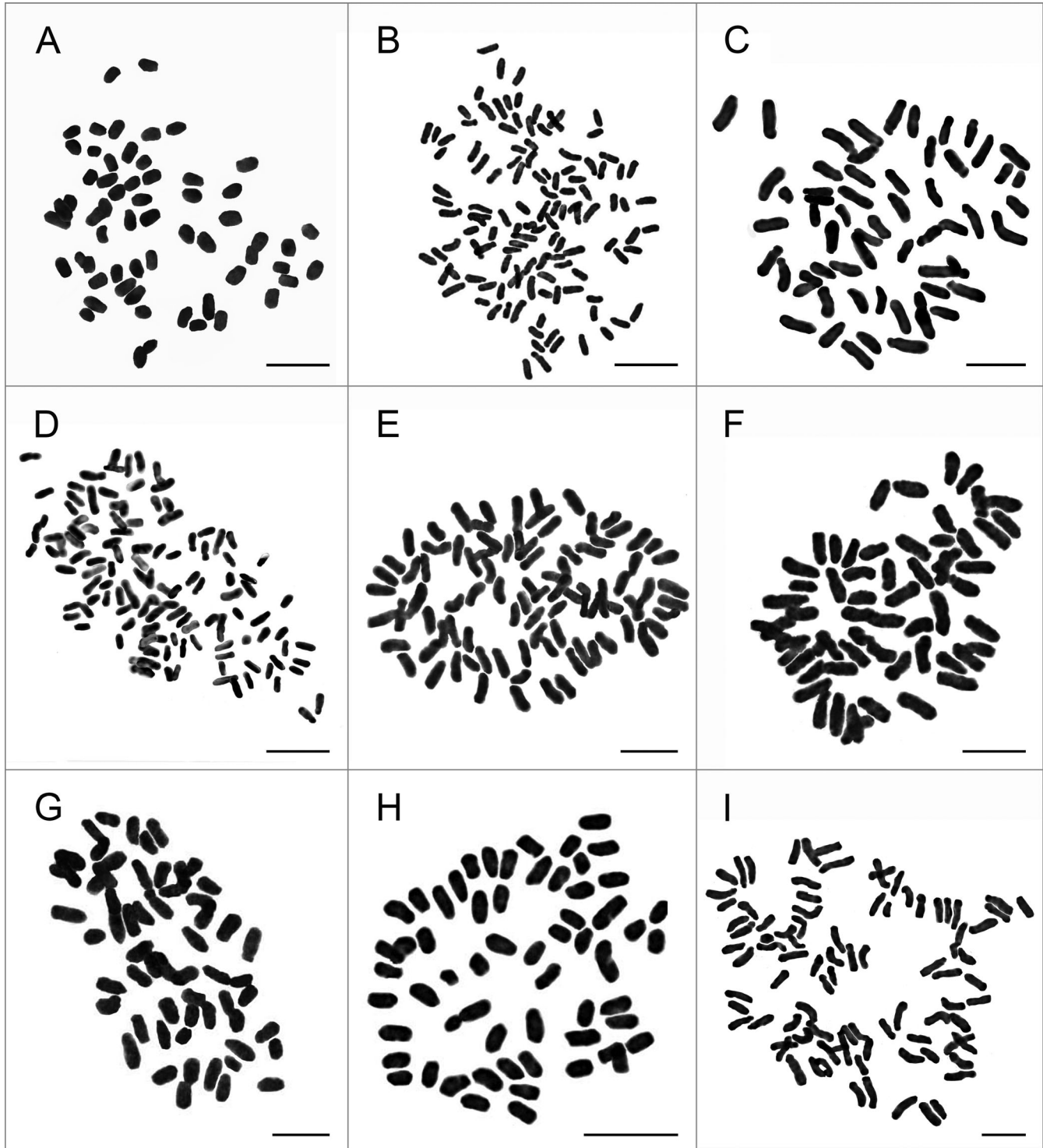


Fig. 15. Photomicrograph of meiotic metaphase. **A**, *Cheilanthes hieronymi*. Photomicrographs of mitotic metaphases: **B**, *Cheilanthes micropteris*; **C**, *Cheilanthes obducta*; **D**, *Cheilanthes pilosa*; **E**, *Cheilanthes pruinata*; **F**, *Cheilanthes squamosa*; **G**, *Doryopteris adornata*; **H**, *Doryopteris concolor*; **I**, *Gagea marginata*. — Scale bars = 5 μ m.

* *Cheilanthes buchtienii* (Rosenst.) R.M.Tryon

$2n = 60$, $x = 30$, CHN. Argentina, Córdoba, Tanti, 31°20'26.6"S, 64°40'03.27"W, 1 Oct 2015, *Morero 403* (CORD) [Fig. 14H].

Ponce & Scataglini (2018) documented sexual and apomictic reproduction for this species based on spore numbers per sporangium.

* *Cheilanthes glauca* (Cav.) Mett.

$2n = 60$, $x = 30$, CHN. Argentina, Chubut, Lago Puelo, 42°05'25"S, 71°35'57"W, 31 Jan 2020, *Morero & Vidoz 519* (CORD) [Fig. 14I].

Ponce & Scataglini (2018) documented sexual reproduction for this species.

* *Cheilanthes hieronymi* Herter

$n = 60$; $x = 30$, CHN. Argentina, Buenos Aires, Sierra de la Ventana, 38°07'S, 61°47'W, s.d., *Arana s.n.* (SI) [Fig. 15A].

Ponce & Scataglini (2018) pointed out that it is a sexual species.

* *Cheilanthes micropteris* Sw.

$2n = 120$, $x = 30$, CHN. Argentina, Córdoba, La Serranita, 31°44'52.49"S, 64°27'41"W, 18 Apr 2015, *Morero & Li 445* (CORD) [Fig. 15B].

Ponce & Scataglini (2018) determined sexual reproduction for this species.

* *Cheilanthes obducta* Mett. ex Kuhn

$2n = 60$, $x = 30$, CHN. Argentina, Jujuy, between San Salvador de Jujuy and San Pedro de Jujuy, 24°18'52.2"S, 64°35'40.3"W, 22 Jan 2019, *Morero & al. 505* (CORD) [Fig. 15C].

This species reproduces sexually, according to Ponce & Scataglini (2018).

* *Cheilanthes pilosa* Goldm.

$2n = 120$, $x = 30$, CHN. Argentina, Jujuy, between San Salvador de Jujuy and El Fuerte, 24°19'08.1"S, 64°31'01"W, 23 Jan 2019, *Morero & al. 508* (CORD) [Fig. 15D].

This species reproduces sexually, according to Ponce & Scataglini (2018).

* *Cheilanthes pruinata* Kaulf.

$2n = 90$, $x = 30$, CHN. Argentina, Córdoba, Sierra Los Gigantes, 31°23'50.69"S, 64°45'17.59"W, 4 Feb 2015, *Morero 428* (CORD) [Fig. 15E].

Apomictic reproduction was recorded for this species by Ponce & Scataglini (2018).

* *Cheilanthes squamosa* Gillies ex Hook. & Grev.

$2n = 60$, $x = 30$, CHN. Argentina, Córdoba, Altas Cumbres, 31°36'15"S, 64°45'34"W, 2 Feb 2020, *Morero 520* (CORD) [Fig. 15F].

Cheilanthes squamosa was reported by Ponce & Scataglini (2018) as a sexual species.

* *Doryopteris adornata* Yesilyurt

$2n = 60$, $x = 30$, CHN. Argentina, Jujuy, Calilegua, 23°44'14.7"S, 64°51'11"W, 24 Jan 2019, *Morero & al. 512* (CORD) [Fig. 15G].

● *Doryopteris concolor* (Langsd. & Fisch.) Kuhn & Decken

$2n = 60$, $x = 30$, CHN. Argentina, Jujuy, Calilegua, 24°21'20.3"S, 65°01'30.8"W, 24 Jan 2019, *Morero & al. 513* (CORD) [Fig. 15H].

Our chromosome number report agrees with at least nine previous records for *D. concolor* (Rice & al., 2015) that documented the

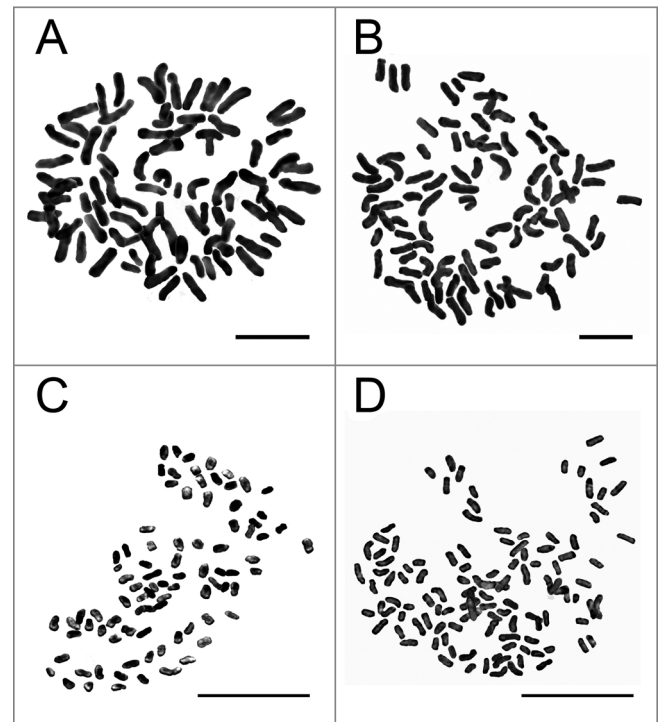


Fig. 16. Photomicrographs of mitotic metaphases. **A**, *Myriopteris aurea*; **B**, *Myriopteris myriophylla*; **C**, *Pellaea ovata*; **D**, *Pellaea ternifolia*. — Scale bars = 5 μ m.

diploid ploidy level for this species; Mitui (1968) reported a tetraploid cytotype ($2n = 120$) for this species.

* *Gaga marginata* (Kunth) Fay W.Li & Windham

$2n = 90$, $x = 30$, CHN. Argentina, Córdoba, Cerro Champaqui, 31°59'46.6"S, 64°52'07.6"W, 24 Nov 2005, *Morero 151* (CORD) [Fig. 15I].

Our report is in accordance with the reproduction mode and ploidy level (apomictic triploid) proposed by Li & al. (2012), and Ponce & Scataglini (2018), based on spore analyses.

● *Myriopteris aurea* (Poir.) Grusz & Windham

$2n = 90$; $x = 30$, CHN. Argentina, Jujuy, San Pedro de Jujuy, 24°30'49.3"S, 65°20'37.3"W, 22 Jan 2019, *Morero & al. 501* (CORD) [Fig. 16A].

We confirm the chromosome number for *M. aurea* published by Knobloch & al. (1973) and Windham & Yatskievych (2003), the former reported under the name of *Notholaena aurea* (Poir.) Desv., and the latter under *Cheilanthes bonariensis* (Willd.) Proctor.

● *Myriopteris myriophylla* (Desv.) J.Sm.

$2n = 90$, $x = 30$, CHN. Argentina, Córdoba, La Serranita, 31°45'08.49"S, 64°28'02.39"W, 18 Apr 2015, *Morero 453* (CORD) [Fig. 16B].

Our chromosomal record for this apomictic triploid species is consistent with previous reports published by Loyd (1966) and Knobloch & al. (1975).

● *Pellaea ovata* (Desv.) Weath.

$2n = 87$, $x = 29$, CHN. Argentina, Salta, La Caldera, 24°42'32.9"S, 65°22'57.4"W, 21 Jan 2019, *Morero & al. 498* (CORD) [Fig. 16C].

Tryon (1968) reported two cytotypes for *P. ovata*, a sexual diploid cytotype from the U.S.A. and an apomictic triploid cytotype

from Mexico; the latter agrees with our chromosome number report.

● *Pellaea ternifolia* (Cav.) Link

$2n = 116, x = 29$, CHN. Argentina, Córdoba, Los Mogotes, 30°50' 30"S, 64°32'41"W, 4 Dec 2004, *Morero 65* (CORD) [Fig. 16D].

Two counts from Mexico, according to Tryon (1968), revealed sexual diploid and sexual tetraploid cytotypes for *P. ternifolia*. Our chromosome count is consistent with the latter record for this species.

The mitotic chromosome counts reported here were obtained from greenhouse-grown plants, while the unique meiotic chromosome count was acquired from fertile leaves of field-collected plants. Preparations of mitotic chromosomes at metaphase were done from fragments of crosiers (~2 mm wide), pretreated with 2 mM 8-hydroxyquinoline for 8 h at 14°C, fixed in 3 : 1 ethanol : acetic acid, and stored at –20°C until use. At the time of staining, the fragments were rinsed in distilled water and then hydrolyzed with cellulase 2%-pectinase 20%, for 15 min at 37°C. After that the digested material was washed three or four times to remove residual enzymes. Then, fragments were stained in alcoholic hydrochloric acid-carmin and squashed in a drop of 45% acetic acid (as detailed in Guillén & Daviña, 2005). Meiotic chromosome counts were obtained from immature fertile fronds, fixed in the field in 1 part glacial acetic : 3 parts absolute alcohol. At the moment of examination, fixed material was transferred to a slide with a drop of 1% aceto-carmin and squashed following classical methods (Manton, 1950).

At least 10 meiotic or mitotic cells of each species that yielded clearly interpretable counts were photographed with phase contrast in an Olympus-BX61 microscope. Mitotic and meiotic photomicrographs were used to determine chromosome numbers with the free software ImageJ v.2 (Schneider & al., 2012).

Cheilantheid ferns (Pteridaceae, subfamily Cheilantheoideae) are frequent in xeric and semixer environments of most regions throughout the World, with the highest diversity in the western United States and Mexico (Tryon & al., 1990).

Cheilantheoideae (sensu PPG I, 2016) comprises around 426 species, of which approximately 140 have been studied cytologically (~33 %; Manton, 1958; Knobloch, 1966a, 1967; Knobloch & al., 1975; Löve & al., 1977; Goldblatt & Johnson, 1979+; Windham & Yatskievych, 2003; Rice & al., 2015). Species from North America have received special attention; about 70% of them have chromosomal data (Windham & Rabe, 1993). In contrast, only 15 species have so far published chromosome number reports (Goldblatt & Johnson, 1979+; Hernández & al., 2015; Rice & al., 2015; Neira & al., 2017) out of the 46 cheilantheid ferns present in southern South America (Zuloaga & al., 2008).

Cheilantheid genera include three basic chromosome numbers, $x = 27$, $x = 29$, and $x = 30$. The first is restricted to *Argyroschisma* (J.Sm.) Windham and represents a potential synapomorphy for the genus (Windham, 1987; Gastony & Rollo, 1998). The second was recorded in *Astrolepis* D.M.Benham & Windham, *Paragymnopteris* K.H.Shing and *Pellaea* Link (Kirkpatrick, 2007), and the third is the most widespread basic number among the genera (*Adiantopsis* Fée, *Aspidotis* (Nutt. ex Hook.) Copel., *Bommeria* E.Fourn., *Cheilanthes* Sw., *Cheilopteron* Fée, *Doryopteris* J.Sm., *Hemionitis* L., and *Notholaena* R.Br.). Further, *Myriopteris* Fée, an uncommon case in ferns cytology, exhibit two basic chromosome numbers, $x = 29$ and $x = 30$ (Grusz & al., 2014).

Taxonomic delimitation of cheilantheid taxa based only on morphological features has generated taxonomic controversies because

they often show convergent evolution. One of the most important issues was the circumscription of the large genus *Cheilanthes*, which used to include most of the cheilantheid species. Recent phylogenetic studies contributed towards the understanding of the cheilantheid relationships (Gastony & Rollo, 1995, 1998; Prado & al., 2007; Schuettelpeiz & al., 2007; Zhang & al., 2007; Bouma & al., 2010; Link-Pérez & al., 2011; Sigel & al., 2011; Li & al., 2012; Grusz & Windham, 2013; Grusz & al., 2014), which resulted in the proposal of newly circumscribed genera (Link-Pérez & al., 2011; Li & al., 2012; Ponce & Scataglini, 2012; Grusz & Windham, 2013; Zhang & al., 2013). Most recently, Ponce & Scataglini (2018) greatly improved the *Cheilanthes* delimitation and its intrageneric relationships by including a broad set of South American species in their phylogeny, most of them without published chromosomal data. However, the circumscription of *Cheilanthes* is still far from being resolved.

Many cheilantheid ferns exhibit both sexual and apomictic life cycles. Chromosome data and spore number per sporangium have been used to estimate the reproductive mode of each species (Knobloch, 1966b); also, in the absence of chromosomal information, the ploidy level was usually inferred from the spore size (Grusz & al., 2009; Beck & al., 2010). The reproduction mode, in combination with molecular and cytological data, has largely clarified the phylogenetic relationships in this group (Beck & al., 2010; Sigel & al., 2011; Li & al., 2012; Grusz & al., 2014). However, South American species relationships are not yet fully elucidated, and it requires additional information to improve their classification and circumscription (Ponce & Scataglini, 2018). Regarding this subject, we provide a set of chromosomal counts of species from Argentina that will help to clarify the systematics and evolution of this group.

In this contribution, we publish chromosome data for 22 cheilantheid ferns collected in Argentina. Counts of 12 species are reported for the first time, while the remaining 10 records corroborate previously published data. Our dataset confirmed the chromosome base numbers of 27, 29 and 30 for the cheilantheid genera studied. Patterns of chromosomal evolution in Cheilantheoideae revealed that the plesiomorphic base number of $x = 30$ has been reduced independently in several lineages during the evolution of this group of ferns (Kirkpatrick, 2007). Our data exhibited an array of different ploidy levels including 2x, 3x and 4x. All *Adiantopsis*, *Argyroschisma* and *Doryopteris* species examined, as well as four *Cheilanthes* species, were diploid, whereas polyploid counts were recovered for *Astrolepis* (3x), *Gaga* (3x), *Myriopteris* (3x), *Pellaea* (3x and 4x), and the remaining *Cheilanthes* studied (3x and 4x). Among the polyploids, six triploid apomictic species were detected. Polyploidy, hybridization and apomixis are frequent in cheilantheid ferns, suggesting that they have played an important role in the diversification and evolution of this group (Windham & Yatskievych, 2003; Sigel & al., 2011; Li & al., 2012).

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IAPT chromosome data 33/10

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* indicates mixoploidy.

POACEAE

Poa faberi Rendle

$2n = 4x, 5x = 28, 35^*$, CHN (N = 15). China, Sichuan, Hengduan Mountains, Garze Tibetan Autonomous Prefecture, Garze County, on shady stones, 30.65344°N, 102.42864°E, 3369 m, 12 Sep 2015, *Y.-Sh. Chen, M. Olova s.n.* (TK 15-91, PE).

Poa incerta Keng ex L.Liu

$2n = 4x = 28$, CHN (N = 3). China, Sichuan, Hengduan Mts., Liangshan Yi Autonomous Prefecture, Muli Tibetan Autonomous County, on the cliffs, 28.237056°N, 101.177861°E, 3356 m, 27 Aug 2015, *Y.-Sh. Chen, M. Olova s.n.* (TK 15-137, PE).

$2n = 4x = 28$, CHN (N = 2). China, Sichuan, Hengduan Mts., Yanan, Shimian County, cliffs of the city, 30.03573°N, 101.95988°E, 2612 m, 9 Sep 2015, *Y.-Sh. Chen, M. Olova s.n.* (TK 15-119, PE).

$2n = 6x = 42$, CHN (N = 5). China, Sichuan, Hengduan Mts., Liangshan Yi Autonomous Prefecture, Muli Tibetan Autonomous County, on a riverbank, 28.38461°N, 100.77348°E, 3653 m, 30 Aug 2015, *Y.-Sh. Chen, M. Olova s.n.* (TK 15-59, PE).

Poa psilolepis Keng

$2n = 4x = 28, 2n = 5x = 35, 2n = 4x, 5x = 28, 35^*, 2n = 4x, 5x, 6x = 28, 35, 42^*$, CHN (N = 22). China, Sichuan, Hengduan Mts., Garze Tibetan Autonomous Prefecture, Garze County, on the wall

of a cloister, 30.54412°N, 101.5511°E, 3442 m, 11 Sep 2015, *Y.-Sh. Chen, M. Olova s.n.* (TK 15-105, PE).

Poa scabriculmis N.R.Cui

$2n = 5x = 35$, CHN (N = 2). China, Sichuan, Kangding County, Mt. Zheduo, near Kangding Airport, among thickets on gravel slopes, 30.1803°N, 101.7402°E, 4350 m, 10 Sep 2015, *Y.-Sh. Chen, M. Olova s.n.* (TK 15-150, PE).

Southern China is naturally gifted with highly diverse flora along an altitudinal gradient from sea level to more than 8000 m. The Hengduan Mts. in Sichuan Province show extreme differences in topography and climate, numerous isolated island-like high peaks and ridges and a wide diversity of habitats. These factors make the Hengduan Mts. one of the most significant biodiversity centers in extratropical Asia (Boufford, 2014). A landscape of high mountains with steep slopes, separating confined valleys, has favored the isolation of plant populations and the preservation of their karyological and genetic diversities. Despite the high interest of the Hengduan Mts. flora, it has been poorly researched due to the inaccessibility to these places. In August–September of 2015, a field expedition of the Institute of Botany, Chinese Academy of Sciences was organized, aiming to uncover the phytodiversity of northwest Sichuan within the framework of the large-scale “Flora of the Pan Himalaya” project.

As a consequence of frequent hybridization and apomixis processes (Tzvelev, 1976; Probatova, 1985), bluegrasses of *Poa* sect. *Stenopoa* Dumort., especially its xeromorphic group, are one of the most taxonomically intricate taxa among the temperate grasses. In Sichuan Province, this section is mostly represented by agamic complexes that consist of many close morphotypes of vague taxonomic status. Some of these taxa were described as species. However, the lack of information on their morphological variability, karyology and evolutionary relationships make their assignment to species-level tentative. Nonetheless, we have treated them here as microspecies within aggregates. The species under consideration belong to four aggregates.

Poa faberi Rendle may have arisen from hybridizations of *P. faberi* (*P.* sect. *Stenopoa*) with some species of *P.* sect. *Homalopoa* Dumort. *Poa faberi* is quite common in the highlands of central and southwestern China. The largest morphological diversity of this species is found in Sichuan and Xizang.

Poa incerta Keng ex L.Liu belongs to the large and widespread *P. versicolor* Besser aggregate. The species of this aggregate are supposed to be a xeromorphic derivative of *P. palustris* L. and are represented in Eurasia by several species that replace each other in different regions. All the morpho-species of this complex are connected by populations showing intermediate traits and are differentiated mostly by combinations of diverse characters.

The *Poa psilolepis* Keng ex L.Liu aggregate combines the morphological features of the *P. versicolor* and *P. glauca* Vahl aggregates, and its taxa are thought to be of hybrid origin. Some morphotypes have been classified within the *P. araratica* Trautv. aggregate, which contains, in turn, several species. Two of them, the Chinese *P. psilolepis* Keng and *P. fragilis* Ovcz., described from the West Pamirs (Tajikistan), differ from other species of this aggregate in their entirely glabrous lemma and can be distinguished from each other based on the size of the whole plant, the spikelets, the lemma and the anthers.

The dwarf species (height 5–15 cm) of *Poa* sect. *Stenopoa* Dumort., which are common in the alpine belt of the Pan Himalaya. All of them represent one of the most problematic groups in the genus. *Poa scabriculmis* N.R.Cui belongs to this group and may have derived from hybridization between *P. attenuata* Trin. and a member

of the *P. glauca* aggregate, *P. albertii* Regel (Olonova & al., 2017). *Poa albertii* was described from Xinjiang and was recently found also in Sichuan (Olonova, 2019).

Taxonomic research on herbarium specimens of these groups has revealed high morphological variability, which can be caused by high karyotypic and genetic variability. Chromosomal analysis of these species has not been performed yet (Goldblatt & Johnson, 1979+). We conducted chromosome counting analysis on the four aggregate species from the Hengduan Mts. (northwest Sichuan, China).

Chromosomal studies were performed following Pukhalskiy & al. (2007). Chromosome counting was done on root tip meristematic metaphase cells. Chromosomes were stained with acetic-hematoxylin and visualized using an AxioStar plus microscope (Carl Zeiss) at 15× 100 magnifications. Image capture was performed with the software AxioVision LE v.4.8.2. Microphotographs were taken using a digital camera Axio Cam ERc 5s. N indicates the number of individual seeds analyzed from each population.

Our study revealed chromosome numbers for *P. faberi*, *P. incerta*, *P. psilolepis* and *P. scabriculumis* from individuals collected in different localities of the Hengduan Mts. Mixoploidy, the existence of different chromosomes numbers within the same individual, was detected in two species – *P. faberi* ($2n = 28, 35$) and *P. psilolepis* ($2n = 28, 35, 28, 35, 42; 4x, 5x, 6x$). Pentaploidy was found in *P. scabriculumis*, and tetraploidy and hexaploidy in *P. incerta*. Long chromosomes (1.71–3.33 μm) were found within *P. incerta* (within the samples TK 15-59, TK 15-119, TK 15-137), and short chromosomes (1.14–2.01 μm) within *P. psilolepis* (TK 15-105).

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IAPT chromosome data 33/11

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* First chromosome count for the species.

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

First chromosome count for Russia.

ASPARAGACEAE

Asparagus officinalis L.

$2n = 40$, CHN. Russia, Republic of Dagestan, Kumtorkalinskii Raion, left riverside of the Shura-ozen' River, S part of sandy hill Sary-Kum, 120 m, on sands, 10 Aug 2019, *D.A. Krivenko 13484* (IRK, LE, VLA).

Asparagus persicus Baker

$2n = 40$, CHN. Russia, Republic of Dagestan, Kumtorkalinskii Raion, left riverside of the Shura-ozen' River, S part of sandy hill Sary-Kum, 130 m, on sands, 10 Aug 2019, *D.A. Krivenko 13475* (IRK, VLA).

ASTERACEAE (COMPOSITAE)

Conyza canadensis (L.) Cronquist (≡ *Erigeron canadensis* L.)

$2n = 18$, CHN. Kazakhstan, Vostochno-Kazakhstanskaya Oblast', Semei town, Polkovnichii Island on Irtysh River, weedy-ruderal plant communities, 23 Sep 2018, *D.A. Krivenko 13423* (IRK, VLA); Russia, Republic of Dagestan, Makhachkala city, Kirovskii District, Leninkent settlement, 2-d microdistrict, 8-line, 90 m, weedy-ruderal plant communities, 19 Aug 2019, *D.A. Krivenko 13485* (IRK, VLA).

BORAGINACEAE

Heliotropium lasiocarpum Fisch. & C.A.Mey.

$2n = 32$, CHN. Armenia, Erevan city, at the entrance of Tsitsernakaberd Park, 1030 m, weedy-ruderal plant communities, 29 Jul 2019, *D.A. Krivenko & al. 13456* (IRK, VLA).

CAPRIFOLIACEAE

Scabiosa bipinnata K.Koch

$2n = 16$, CHN. Georgia, Shida-Kartli Region, Kareli Municipality, 2 km WNW of Urbnici village, left riverside of the Kura River, 740 m, in *Spartium* bush, 24 Jul 2019, *A.A. Markaryan & D.A. Krivenko 13454* (IRK, VLA).

CARYOPHYLLACEAE

Stellaria bungeana Fenzl

** $2n = 26$, CHN. Russia, Republic of Buryatia, Kabanskii Raion, SE shore of Lake Baikal, valley of Bol'shoi Mamai River, 483 m, dark coniferous forest, 13 Jul 2018, *D.A. Krivenko 13425* (IRK, VLA).

EUPHORBIACEAE

Acalypha australis L.

$2n = 40$, CHN. Russia, Republic of Dagestan, Makhachkala city, Kirovskii District, Leninkent settlement, 2-d microdistrict, 8-line, 90 m, weedy-ruderal plant communities, 19 Aug 2019, *D.A. Krivenko 13453* (IRK, VLA).

LAMIACEAE (LABIATAE)

Ajuga chia Schreb. (≡ *A. chamaepitys* subsp. *chia* (Schreb.) Arcang.)

$2n = 30$, CHN. Georgia, Samtskhe-Javakheti Region, Akhaltsikhe Municipality, right riverside of the Kura River, on the way from

Greli village to Sapara monastery, 1290 m, graded steppe slope, 23 Jul 2019, *D.A. Krivenko & al. 13476* (IRK, VLA).

Scutellaria orientalis L.

$2n = 22$, CHN. Armenia, Vayots Dzor Province, right riverside of the Arpa River, 9 km NE of Malishka village, the crater of Vayots Sar (Tapasi-Dalik) Volcano, 2557 m, stony forb steppe meadow, 21 Jul 2019, *D.A. Krivenko & al. 13464* (IRK, VLA).

* *Sideritis comosa* (Rochel ex Benth.) Stankov

$2n = 16$, CHN. Georgia, Samtskhe-Javakheti Region, Akhaltsikhe Municipality, right riverside of the Kura River, on the way from Greli village to Sapara monastery, 1290 m, graded steppe slope, 23 Jul 2019, *D.A. Krivenko & al. 13448* (IRK, VLA).

NITRARIACEAE

Peganum harmala L.

$2n = 24$, CHN. Georgia, Shida-Kartli Region, Gori Municipality, Kartli valley, at the interflow of Kura River and its left tributary, Greater Liakhvi River, Gori town, the castle Goristsikhe, 610 m, forb steppe slope, 24 Jul 2019, *D.A. Krivenko & al. 13452* (IRK, VLA).

PAPAVERACEAE

Dicentra peregrina (Rudolph) Makino

$2n = 16$, CHN. Russia, Far East, Kamchatskii Krai, Kamchatka Peninsula, Tigil'skii Raion, upper course of the Palana River, in vicinity of Palanskie hot springs, dry melkozem debris stream, 8 Sep 2019, *O.A. Chernyagina 13431* (VLA).

PLANTAGINACEAE

Plantago lanceolata L.

$2n = 12$, CHN. Russia, Republic of Dagestan, Makhachkala city, Kirovskii District, Leninkent settlement, 2-d microdistrict, 8-line, 90 m, weedy-ruderal plant communities, 19 Aug 2019, *D.A. Krivenko 13451* (IRK, VLA).

POACEAE (GRAMINEAE)

Achnatherum sibiricum (L.) Keng ex Tzvelev

$2n = 24$, CHN. Russia, East Siberia, Irkutskaya Oblast', Ol'khonskii Raion, Lake Baikal, Ol'khon Island, Uzury settlement, steppe, 711 m, 2 Oct 2018, *O.Yu. Zavgorodnyaya 13432* (VLA).

Anisantha tectorum var. *hirsuta* (Regel) Tzvelev

$2n = 14$, CHN. Georgia, Samtskhe-Javakheti Region, Akhaltsikhe Municipality, right riverside of the Kura River, on the way from Greli village to Sapara monastery, 1290 m, graded steppe slope, 23 Jul 2019, *D.A. Krivenko & al. 13457* (IRK, VLA); Russia, Kabardino-Balkaria Republic, Cherekskii Raion, Glavnyi Kavkazskii Range, Cherekskoe gorge, former Zilgi village, left riverside of the Cherek Balkarskii River, abandoned apple trees garden, 1150 m, 8 Aug 2019, *D.A. Krivenko 13480* (IRK, VLA).

Bromopsis australis (Zherebina) Tzvelev & Prob.

$2n = 56$, CHN. Russia, East Siberia, Krasnoyarskii Krai, Krasnoyarsk city, northern outskirts, disturbed meadow, 18 Jul 2019, *E.B. Volynets 13422* (VLA).

Bromopsis biebersteinii (Roem. & Schult.) Holub (≡ *Bromus biebersteinii* Roem. & Schult.)

$2n = 28$, CHN. Georgia, Samtskhe-Javakheti Region, Akhaltsikhe Municipality, right riverside of the Kura River, on the way from

Greli village to Sapara monastery, 1290 m, graded steppe slope, 23 Jul 2019, *D.A. Krivenko & al. 13462* (IRK, VLA).

* *Bromopsis gordjaginii* (Tzvelev) Galushko

$2n = 56$, CHN. Russia, Republic of Dagestan, Dokuzparinskii Raion, Glavnyi Kavkazskii Range, 4 km SSW of Kurush settlement, slope of Mt. Nesindag, right riverside of the Ragdanchai River – right tributary of the Mullarchai River (Chekhychai River basin), 2670 m, steep stony slope, 15 Aug 2019, *D.A. Krivenko 13486* (IRK, VLA).

Bromus commutatus Schrad.

$2n = 14$, CHN. Georgia, Samtskhe-Javakheti Region, Akhaltsikhe Municipality, right riverside of the Kura River, on the way from Greli village to Sapara monastery, 1290 m, graded steppe slope, 23 Jul 2019, *D.A. Krivenko & al. 13459* (IRK, VLA).

Bromus danthoniae Trin. ex C.A.Mey.

$2n = 28$, CHN. Armenia, Gegharkunik Province, Selim (Vardenyats) Pass, 5.5 km S of the abandoned village Nshkhark, above Selim (Orbelyan's) caravanserai, 2400 m, stony places, 21 Jul 2019, *D.A. Krivenko & al. 13468* (IRK, VLA).

Calamagrostis caucasica Trin.

$2n = 28$, CHN. Russia, Republic of Dagestan, Dokuzparinskii Raion, 4 km SSW of Kurush settlement, Glavnyi Kavkazskii Range, slope of Mt. Nesindag, right riverside of the Ragdanchai River – right tributary of the Mullarchai River (Chekhychai River basin), 2670 m, stony, steep slope, 15 Aug 2019, *D.A. Krivenko 13488* (IRK, VLA).

Calamagrostis langsdorffii (Link) Trin.

$2n = 28$, CHN. Russia, East Siberia, Irkutskaya Oblast', Slyudianskii Raion, W lakeside of the Lake Baikal, 98 km of the Krugobaikal'skaya railroad, right riverside of the Pylovka River, 485 m, mixed forest forb margin, 14 Sep 2018, *O.Yu. Zavgorodnyaya 13443* (VLA); Russia, Irkutskaya Oblast', Slyudianskii Raion, W lakeside of the Lake Baikal, 94 km of the Krugobaikal'skaya railroad, right riverside of the Pylovka River, 636 m, forest, 12 Sep 2018, *O.Yu. Zavgorodnyaya 13445* (VLA).

* *Deschampsia biebersteiniana* Roem. & Schult.

$2n = 26$, CHN. Russia, Republic of Dagestan, Dokuzparinskii Raion, 4 km NNE of Kurush settlement, Glavnyi Kavkazskii Range, left riverside of the Chekhychai River, 2100 m, matted bank of a mountain stream, 16 Aug 2019, *D.A. Krivenko 13490* (IRK, VLA).

Echinochloa caudata Roshev.

$2n = 36$, CHN. Russia, Far East, Kamchatskii Krai, Kamchatka Peninsula, Mil'kovskii Raion, Malki settlement, Malkinskii springs, at the hot spring, 25 Jul 2017, *O.A. Chernyagina & E.A. Devyatova 13264* (VLA); Russia, Far East, Kamchatskii Krai, Kamchatka Peninsula, Apachinskii springs, on thermal habitats, at the hot spring (introduced in 2010), 29 Aug 2017, *O.A. Chernyagina 13265* (VLA).

Elymus caninus (L.) L.

$2n = 28$, CHN. Georgia, Samtskhe-Javakheti Region, Adigeni Municipality, 7.5 km N of Abastumani settlement, S slope of Meskhet Range, N part of Lesser Caucasus, canyon of the Otskhe (Abastumanka) River, left riverside, 1413 m, coniferous (*Pinus*, *Picea*, *Abies*) forest, 25 Jul 2019, *D.A. Krivenko & al. 13467* (IRK, VLA).

Elymus sibiricus L.

2n = 28, CHN. Russia, East Siberia, Irkutskaya Oblast', Slyudianskii Raion, W lakeside of the Lake Baikal, 98 km of the Krugobaikal'skaya railroad, 456 m, lakeside, 14 Sep 2018, *O.Yu. Zavgorodnyaya* 13442 (VLA).

Hordeum murinum L.

2n = 28, CHN. Armenia, Erevan city, Avan District – NE part of the city (former Avan village), 1340 m, among weedy-ruderal vegetation, 21 Jul 2019, *D.A. Krivenko & al.* 13478 (IRK, VLA).

Hordeum violaceum Boiss. & Hohen.

2n = 14, CHN. Russia, Republic of Dagestan, Dokuzparinskii Raion, Glavnyi Kavkazskii Range, 3 km WSW of Kurush settlement, the Mullarchai River, before inflow of its tributary Ragdanchai River (Chekhychai River basin), opposite Mt. Ragdan, 2380 m, riverside, forb meadow, 16 Aug 2019, *D.A. Krivenko* 13465 (IRK, VLA).

Poa angustifolia L.

2n = 56, CHN. Russia, Far East, Kamchatskii Krai, Kamchatka Peninsula, Elizovskii Raion, Ganaly settlement, waste area, 27 Jul 2017, *O.A. Chernyagina* 13466 (VLA).

Poa humilis Ehrh. ex Hoffm. (= *P. subcaerulea* Sm.)

** 2n = 63, CHN. Russia, Far East, Kamchatskii Krai, Kamchatka Peninsula, Palana settlement, waste place on the edge of a slope, 23 Jul 2018, *O.A. Chernyagina* 13398 (VLA).

Poa nemoralis L.

2n = 28, CHN. Russia, Kabardino-Balkaria Republic, Elbrusskii Raion, Bokovyi Range of Glavnyi Kavkazskii, Baksanskoe gorge, left riverside of the Baksan River, 18 km E of Elbrus Mt., in vicinity of Tegenekli village, 1860 m, forested mountain slope, 7 Aug 2019, *D.A. Krivenko* 13489 (IRK, VLA).

Poa sergievskajae Prob.

2n = 56, CHN. Russia, East Siberia, Irkutskaya Oblast', Irkutskii Raion, southwest coast of Lake Baikal, Khargino Cove, 27 Aug 2018, *O.Yu. Zavgorodnyaya* 13437 (VLA).

Schedonorus pratensis (Huds.) P.Beauv. (= *Lolium pratense* (Huds.) Darbysh.)

2n = 14, CHN. Armenia, Shirak Province, Ashotsk Municipality, between Ashotsk and Mez Sepasar settlements, 2020 m, ruderal steppe, 26 Jul 2019, *D.A. Krivenko & al.* 13463 (IRK, VLA).

Setaria viridis (L.) P.Beauv.

2n = 18, CHN. Armenia, Erevan city, Karapet Ulnessi Str., 1170 m, roadside, 27 Jul 2019, *D.A. Krivenko & al.* 13491 (IRK, VLA); Kazakhstan, Vostochno-Kazakhstanskaya Oblast', Semei town, Polkovnichii Island on the Irtysh River, weedy-ruderal plant communities, 23 Sep 2018, *D.A. Krivenko* 13426 (IRK, VLA); Russia, Republic of Dagestan, Makhachkala city, Kirovskii District, Leninkent settlement, 2-d microdistrict, 8-line, 90 m, weedy-ruderal plant communities, 19 Aug 2019, *D.A. Krivenko* 13487 (IRK, PVB, TASH, VLA).

Stipa capillata L.

2n = 44, CHN. Russia, West Siberia, Altaiskii Krai, Pospelikhinskii Raion, 6 km W of the Mamontovo village, Magistral'nii channel, feather-grass steppe, 19 Sep 2018, *D.A. Krivenko* 13436 (IRK, VLA).

Tragus racemosus (L.) All.

2n = 40, CHN. Georgia, Shida-Kartli Region, Kareli Municipality, 2 km WNW of Urbnici village, left riverside of the Kura River, 740 m, stony roadside, 24 Jul 2019, *D.A. Krivenko* 13461 (IRK, VLA).

Trisetum transcaasicum Seregin (= *T. buschianum* subsp. *transcaasicum* (Seregin) Mosul.)

2n = 28, CHN. Russia, Republic of Dagestan, Dokuzparinskii Raion, Glavnyi Kavkazskii Range, 3 km WSW of Kurush settlement, the island between two horns of the Mullarchai River (Chekhychai River basin), opposite Mt. Nesindag, 2340 m, grassy (*Trisetum*) sandy-pebbly riverside, 16 Aug 2019, *D.A. Krivenko* 13470 (IRK, VLA).

POLYGONACEAE*Rumex chalepensis* Mill.

2n = 40, CHN. Armenia, Kotayk Province, at the border with Ararat Province, right riverside of the Azat River, Gokht village, 1690 m, weedy-ruderal plant communities, 28 Jul 2019, *D.A. Krivenko & al.* 13450 (IRK, VLA).

Rumex patientia L.

2n = 40, CHN. Russia, Far East, Kamchatskii Krai, Kamchatka Peninsula, Bystrinskii Raion, Esso settlement, as weed in a vegetable garden, 22 Aug 2017, *O.A. Chernyagina* 13434 (VLA).

PRIMULACEAE*Androsace filiformis* Retz.

2n = 20, CHN. Russia, Far East, Kamchatskii Krai, Kamchatka Peninsula, Palana settlement, moist meadow at the rivulet, 17 Jul 2018, *O.A. Chernyagina* 13427 (VLA).

RANUNCULACEAE*Anemone sylvestris* L. (= *Anemonoides sylvestris* (L.) Galasso, Banfi & Soldano)

2n = 16, CHN. Russia, East Siberia, Krasnoyarskii Krai, Rybinskii Raion, meadow near Borodino town, 2 Jul 2019, *E.B. Volynets* 13429 (VLA).

Pulsatilla nuttalliana (DC.) Spreng.

2n = 16, CHN. Russia, Far East, Kamchatskii Krai, Kamchatka Peninsula, Tigil'skii Raion, outskirts of Palana settlement, forb meadow on the slope of a marine terrace, 22 Jul 2018, *O.A. Chernyagina* 13430 (VLA).

RESEDACEAE*Reseda lutea* L.

2n = 48, CHN. Georgia, Shida-Kartli Region, Gori Municipality, Kartli valley, at the interflow of the Kura River and its left tributary Greater Liakhvi River, Gori town, the castle Goristsikhe, 610 m, forb steppe slope, 24 Jul 2019, *D.A. Krivenko & al.* 13455 (IRK, VLA).

RUBIACEAE*Rubia tinctorum* L.

2n = 44, CHN. Armenia, Erevan city, Tsitsernakaberd Park, 1060 m, weedy-ruderal plant communities, 29 Jul 2019, *D.A. Krivenko & al.* 13473 (IRK, LE, TASH, VLA).

SOLANACEAE*Solanum persicum* Willd. ex Roem. & Schult.

2n = 24, CHN. Armenia, Erevan city, Tsitsernakaberd Park, 1080 m, among shrubs, 31 Jul 2019, *D.A. Krivenko & al.* 13471 (IRK, VLA).

IAPT chromosome data 33/12

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- * First gametic chromosome count for the cytotype.
- ** First somatic chromosome count for a specimen from Argentina.
- ▼ First gametic chromosome count for a specimen from Argentina.
- First gametic chromosome count for a specimen from Paraguay.

POACEAE

Paspalum aff. *arundinellum* Mez

$2n = 50$, CHN. Argentina, Misiones Province, Capital Department, Villa Lanús, Refugio Don Lorenzo, 21 Sep 1992, *A.I. Honfi 179* (MNES).

This pentaploid cytotype ($2n = 5x = 50$) has already been reported from other Argentinian locations (Honfi & al., 1990; Hojsgaard & al., 2009).

* *Paspalum falcatum* Nees ex Steud.

$n = 10$, CHN. Argentina, Misiones Province, Candelaria Department, Corpus, 16 Feb 2000, *R.D. Almada 74* (CTES, MNES, SI) [Table 4, Fig. 17A].

Chromosomal associations at meiosis with 10II were counted at diakinesis and metaphase I in pollen mother cells (PMCs) and indicate diploidy for this species. Meiosis was regular in all analyzed PMCs, and no univalent was observed. This is the first report of meiotic chromosome configuration at the diploid level in this species. Previous gametic chromosome counts were reported for the tetraploid cytotype by Burson (1997).

** *Paspalum glaucescens* Hack.

$2n = 40$, CHN. Argentina, Misiones Province, Candelaria Department, Bonpland, road to Mártires Chico stream, 19 Mar 1991, *A.I. Honfi 109* (MNES) [Fig. 18A].

This is the first somatic chromosome report for a tetraploid cytotype in Misiones (Argentina), which complements the gametic analysis of material from Formosa, Argentina (Morrone & al., 2006). Previous somatic reports of tetraploids have been made on materials from Brazil and Paraguay (Pagliarini & al., 2001; Pozzobon & al., 2008; Hojsgaard & al., 2009).

Paspalum indecorum Mez

$n = 10$, CHN. Argentina, Misiones Province, Candelaria Department, Santa Ana, 8 Apr 2010, *A.I. Honfi 1458* (MNES) [Table 4, Fig. 17B–D].

Chromosomal associations at meiosis with 10II and occasionally 9II + 2I were observed at diakinesis in PMCs. Meiosis was regular with a low frequency of univalents at diakinesis or metaphase I. Our count confirms previous gametic reports from Argentinian and Brazilian locations (Quarin & Burson, 1983; Hunziker & al., 1998; Pagliarini & al., 2001).

Paspalum jurgensii Hack.

$2n = 20$, CHN. Argentina, Misiones Province, Capital Department, Posadas, 19 Feb 1994, *A.I. Honfi 597* (MNES).

Our count confirms previous reports on somatic chromosomes in accessions from Brazil (Vaio & al., 2007; Pozzobon & al., 2000; Burson & Bennett, 1971), Uruguay (Vaio & al., 2007), Argentina and Paraguay (Hojsgaard & al., 2009).

▼ *Paspalum limbatum* Henrard

$n = 10$, CHN. Argentina, Misiones Province, Capital Department, Posadas, 22 Sep 2003, *D.H. Hojsgaard 295* (MNES) [Table 4, Fig. 17E,F].

Chromosomes in this diploid cytotype behave regularly at meiosis and form 10II, rarely 9II + 2I. This gametic chromosome number represents the first record for the territory of Argentina, and our results confirm previous reports for diploid accessions from Bolivia and Paraguay (Espinoza & al., 2001).

Table 4. Meiotic chromosome pairing in seven *Paspalum* species.

Species and vouchers	Ploidy level	No. of PMCs	Average chromosomal associations (and range) per PMCs at diakinesis/metaphase I		
			I	II	IV
<i>P. falcatum</i>	2x	65	–	10 (10)	–
<i>P. indecorum</i>	2x	21	0.29 (0–2)	9.86 (9–10)	–
<i>P. limbatum</i>	2x	139	0.04 (0–2)	9.96 (9–10)	–
<i>P. orbiculatum</i>	2x	18	–	9.63 (8–10)	0.18 (0–1)
<i>P. polyphyllum</i>	4x	18	0.25 (0–2)	10.62 (9–16)	4.62 (2–5)
<i>P. repens</i>	2x	88	0.05 (0–2)	9.95 (9–10)	–
<i>P. umbrosum</i>	2x	133	0.03 (0–2)	9.97 (9–10)	–

PMC, pollen mother cell; I, univalents; II, bivalents; IV, tetravalents.

Paspalum maculosum Trin.

$2n = 20$, CHN. Argentina, Misiones Province, Capital Department, Villa Lanús, Zaiman swampland, near el Porvenir neighborhood, 25 Nov 2013, *A.I. Honfi 1703* (MNES).

The diploid cytotype of this species has been previously reported in material from Corrientes (Argentina) and from Brazil and Bolivia (Norrman & al., 1989, 1994; Killeen, 1990; Pozzobon & al., 2000; Sede & al., 2010).

* *Paspalum orbiculatum* Poir.

$n = 10$, CHN. Paraguay, Paraguari Department, Carapeguá, National Route 1, 21 Mar 2000, *A.I. Honfi & J.R. Daviña 1073* (MNES) [Table 4, Fig. 19A].

Chromosomes behave regularly at meiosis comprising 10II at diakinesis and metaphase I (82% of PMCs), indicating diploidy for this species. Occasionally, tetravalents were observed at low frequencies in PMCs with 8II + 1IV. This is the first study reporting the

meiotic behavior for a diploid cytotype for material from Paraguay. The somatic chromosome number of this species was previously studied in accessions from Colombia and Paraguay (Gould & Soderstrom, 1970; Hojsgaard & al., 2009).

▼ *Paspalum polyphyllum* Nees ex Trin.

$n = 20$, CHN. Argentina, Misiones Province, Capital Department, Garupá, 1 Mar 2003, *D.H. Hojsgaard 264* (MNES) [Table 4, Fig. 19B–E].

The analysis indicates that this material is tetraploid. Chromosomes associate forming $0.3I + 10.6II + 4.6IV$ at diakinesis and metaphase I and show normal segregation with occasional lagging chromosomes. This species had a high frequency of tetravalents per PMC and should be considered an autotetraploid or a segmentary allotetraploid. This is the first report of a meiotic chromosome number for an Argentinian provenance. Our results agree with those in Burson (1997), who also observed a high frequency of tetravalents and laggards in ca. 40% of the cells in anaphase I in plants from Brazil and Uruguay.

Paspalum quarinii Morrone & Zuloaga

$2n = 20$, CHN. Argentina, Misiones Province, Caingúas Department, Campo Grande, 19 Feb 1994, *A.I. Honfi 579* (MNES, CTES) [Fig. 18B].

The present report of a diploid cytotype for this species confirms previous studies in materials from southern Misiones, Argentina (Norrman & al., 1989; Hojsgaard & al., 2009)

Paspalum repens P.J.Bergius

$n = 10$, CHN. Argentina, Misiones Province, Capital Department, Nemesio Parma, 10 Apr 2003, *D.H. Hojsgaard 271* (CTES, MNES, SI) [Table 4, Fig. 19G,H].

Chromosomes in the diploid cytotype of this species behave regularly at meiosis, with 10II at diakinesis and balanced chromosomal segregation despite a few PMCs observed with 9II + 2I. Only one PMC had an anaphase bridge at telophase II, but no micronuclei were observed in any microspore. Previous reports for $n = 10$ were published for accessions from Uruguay and southern Argentina (Burson, 1997; Sede & al., 2010).

● *Paspalum umbrosum* Trin.

$n = 10$, CHN. Paraguay, Itapúa Department, Encarnación, National Route 1, 27 Jan 2003, *J.R. Daviña 554* (CTES, MNES) [Table 4, Fig. 19F].

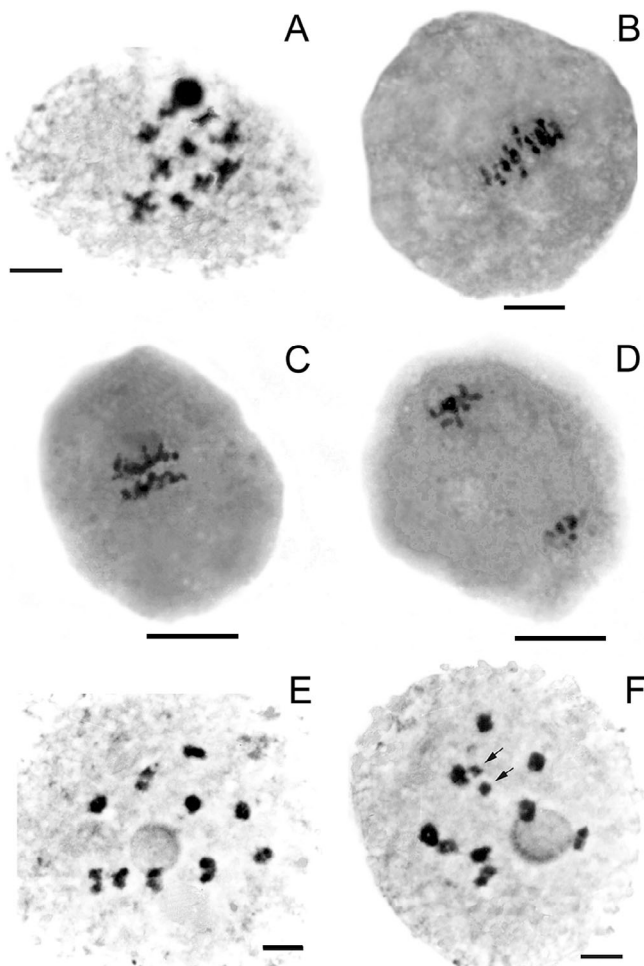


Fig. 17. Meiotic chromosomes. **A**, *Paspalum falcatum*, $n = 10$ (*R.D. Almada 74*), pollen mother cell (PMC) at diakinesis with 10II and nucleolus. **B–D**, *P. indecorum*, $n = 10$ (*A.I. Honfi 1458*): **B**, PMC at metaphase I with 10II; **C**, PMC at early anaphase I with normal chromosome segregation; **D**, PMC at telophase I with normal chromosome-to-pole migration. **E & F**, *P. limbatum*, $n = 10$ (*D.H. Hojsgaard 295*): **E**, PMC with 10II and nucleolus; **F**, PMC with 9II + 2I (arrows). — Scale bars = 5 μm (A, E, F), 10 μm (B–D).

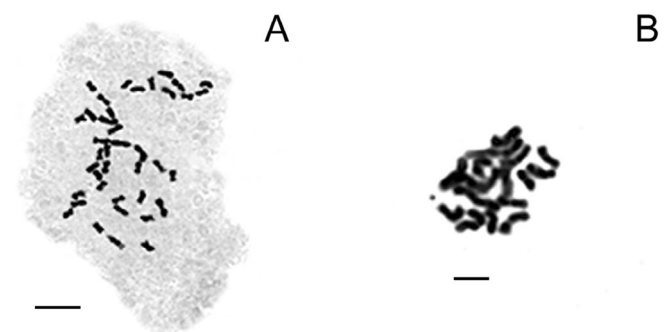


Fig. 18. Mitotic chromosomes. **A**, *Paspalum glaucescens*, $2n = 40$ (*A.I. Honfi 109*); **B**, *P. quarinii* $2n = 20$ (*A.I. Honfi 579*). — Scale bars = 5 μm .

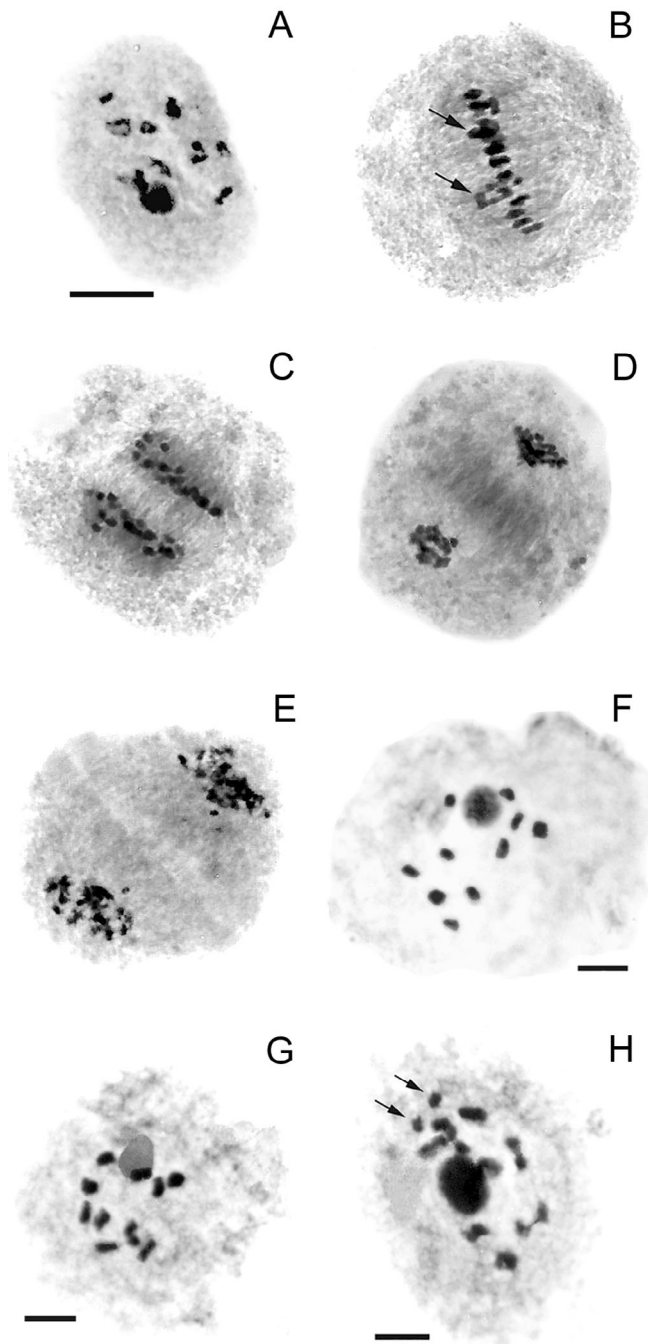


Fig. 19. Meiotic chromosomes. **A**, *Paspalum orbiculatum*, $n = 10$ (A.I. Honfi & J.R. Daviña 1073), pollen mother cell (PMC) at diakinesis with 10II and nucleolus. **B–E**, *P. polyphyllum*, $n = 20$ (D.H. Hojsgaard 264): **B**, PMC at metaphase I with 2I + 15II + 2IV, the IV are marked with arrows; **C**, PMC at anaphase I with normal chromosome segregation; **D**, PMC at telophase I with normal chromosome-to-pole migration; **E**, Cytokinesis after telophase I, dividing the microspore into two equal-sized cells. **F**, *P. umbrosum*, $n = 10$ (J.R. Daviña 554), PMC at diakinesis with 10II and nucleolus. **G** & **H**, *P. repens*, $n = 10$ (D.H. Hojsgaard 271): **G**, PMC at diakinesis with 10II and nucleolus; **H**, PMC at diakinesis with 9II + 2I (arrows) and nucleolus. — Scale bars = 5 μm (A, F–H), 10 μm (B–E).

The meiotic chromosome numbers $n = 10\text{II}$ and $9\text{II} + 2\text{I}$ were counted in PMCs of this diploid species. Meiosis was regular, with a low frequency of univalents. This is the first report of meiotic analyses for an accession from Paraguay. Our study confirms the report of Hunziker & al. (1998) for a plant from Argentina.

Polyploidy has a major role in the evolution of grasses, especially in the Paspaleae tribe, whose genera often include species having multiple cytotypes. These new chromosome counts are especially important regarding the diploid materials. Diploid cytotypes in species of *Paspalum* reproduce sexually, while polyploids are usually apomictic (clonal). For this reason, the finding of new diploid materials contributes to the geographic location of natural sexual populations and areas of variability, to acquire new genotypes and incorporate them in current breeding programs aimed at improving regional forage cultivars and enriching ex situ germplasm for conservation.

METHODS

Chromosome numbers were analyzed following the methodology described in Hojsgaard & al. (2009). Young inflorescences for meiotic studies were fixed in ethanol : glacial acetic acid (3 : 1) for 24 h at room temperature and then stored at 4°C in 70% ethanol until analysis. Anthers were macerated in a glass slide and stained with 2% acetocarmine. All microsporocyte cells at right stages of meiosis were analyzed in each case. Chromosome associations were assessed in at least 18 cells at diakinesis or metaphase per cytotype and a total of 482 cells for all seven cytotypes (Table 4).

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- Federal, Gama, Ponte Alta Norte, in front of the Judiciary Club, 15°57'20.5"S, 48°07'07.9"W, 25 Feb 2019, *R.C. Oliveira 3549* (UB); Brazil, Goiás, Alexânia, District of Olhos d'Água, near the river, roadside, 16°01'33.0"S, 48°35'12.2"W, 10 Apr 2019, *R.C. Oliveira 3625*, *R.C. Oliveira 3626* (UB); Brazil, Goiás, Alvorada do Norte, 14°28'48.2"S, 46°29'29.1"W, 16 Mar 2019, *M.W.S. Sousa & J.G.F. Silva 111*, *M.W.S. Sousa & J.G.F. Silva 112* (UB); Brazil, Goiás, Luziânia, next to Hwy. 040, km 76, between Luziânia and Cristalina, 16°30'57.7"S, 47°48'40.1"W, 30 Mar 2019, *M.W.S. Sousa & al. 120* (UB); Brazil, Goiás, Simolândia, north of the Simolândia–Iaciara road, entering west of the bridge over the Salobro stream, 14°28'23.5"S, 46°29'41.3"W, 16 Mar 2019, *M.W.S. Sousa & J.G.F. Silva 110* (UB).
- Paspalum cordaense* Swallen
 $2n = 40$, CHN. Brazil, Piauí, Monte Alegre do Piauí, towards Santa Filomena, next to the power station, 09°44'56.0"S, 45°20'44.0"W, 15 Jan 2019, *M.W.S. Sousa 102* (UB).
- Paspalum foveolatum* Steud.
 $2n = 20$, CHN. Brazil, Goiás, Alvorada do Norte, 14°34'37.0"S, 46°43'49.0"W, 16 Mar 2019, *M.W.S. Sousa & J.G.F. Silva 113*, *M.W.S. Sousa & J.G.F. Silva 116* (UB); Brazil, Piauí, Monte Alegre do Piauí, 15 November Street, on vacant lot in front of house number 375, 09°44'47.2"S, 45°18'18.3"W, 18 May 2019, *M.W.S. Sousa 134* (UB).
 $2n = 40$, CHN. Brazil, Goiás, Alvorada do Norte, 14°34'37.0"S, 46°43'49.0"W, 16 Mar 2019, *M.W.S. Sousa & J.G.F. Silva 114* (UB).
- Chromosome numbers were determined for 14 accessions of annual and one perennial species of *Paspalum*, in meiosis of pollen mother cells, following Sousa & al. (2017).
- Paspalum* L. is the largest genus of the Panicoideae subfamily with 350 species (Bonasora & al., 2018). Most species have a basic number $x = 10$ chromosomes, and approximately 75% of these are polyploids, some of which forming multiploid complexes (Ortiz & al., 2013). Generally, in this genus, sexual diploids ($2n = 2x = 20$) occur along with co-specific, apomitic tetraploid counterparts ($2n = 4x = 40$) (Bonasora & al., 2018).
- Our results confirm previous counts of $2n = 40$ chromosomes for *P. atratum* (Freitas & al., 1997; Quarin & al., 1997; Takayama & al., 1998; Adamowski & al., 2005), $2n = 32$ for *P. convexum* accessions, a number considered an exception in the genus (Pohl & Davidse, 1971; Selva, 1976; Pozzobon & Valls, 1987; Sousa & al., 2018) and $2n = 40$ for *P. cordaense* (Sousa & al., 2018).
- There are reports of chromosome numbers of $2n = 20$, 40 and 60 for *P. convexum* in the literature (Gould, 1966; Reeder, 1967; Pohl & Davidse, 1971; Davidse & Pohl, 1974; Reeder, 1984). However, we examined vouchers of such divergent counts assigned to *P. convexum* and concluded they belong to the morphologically close species *P. foveolatum* Steud.
- Recently, Sousa & al. (2018) reported counts of $2n = 20$ and 40 chromosomes for 11 accessions of *P. foveolatum* (under the name *P. melanospermum* Desv. ex Poir.) that confirm the numbers for this species. In this work, the accessions analyzed and identified as *P. foveolatum* document the co-existence of the two ploidy levels, in sympatry, in Alvorada do Norte (Sousa & Silva 113, 116 – $2n = 20$, 114 – $2n = 40$).
- This paper emphasizes the high incidence of tetraploidy in species belonging to the Plicatula group, the validation of the somatic

IAPT chromosome data 33/13

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* First chromosome count for the species.

POACEAE

Paspalum atratum Swallen

$2n = 40$, CHN. Brazil, Distrito Federal, Brasília, lawn by parking lot of Embrapa Recursos Genéticos e Biotecnologia, 15°43'49.7"S, 47°54'10.2"W, 20 Feb 2019, *M.W.S. Sousa 107* (UB).

Paspalum convexum Humb. & Bonpl. ex Flügge

$2n = 32$, CHN. Brazil, Distrito Federal, Brasília, lawn by parking lot of Embrapa Recursos Genéticos e Biotecnologia, 15°43'50.3"S, 47°54'10.0"W, 20 Feb 2019, *M.W.S. Sousa 106* (UB); Brazil, Distrito

number $2n = 32$ for *P. convexum*, as well as the presence of species with sympatric diploid and tetraploid cytotypes.

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IAPT chromosome data 33/14

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▲ Polysomatic species.

* New chromosome number (cytotypes) for the species.

Chromosomes were counted according to the method of Guerra & Souza (2002).

LEGUMINOSAE

Subfamily Caesalpinioideae sensu lato

Tribe Cassieae

Senna obtusifolia (L.) H.S.Irwin & Barneby

$2n = 26$, CHN. Brazil, Bahia, Paulo Afonso, road to the Belvedere Park, 09°23'23"S, 38°13'24"W, 29 Jun 2018, *P.L.B.N. Melo & al. 03* (HUNEB).

▲ $2n = 26$ and 52, CHN. Brazil, Pernambuco, Serra Talhada, Mata da Pimenteira State Park, Lagoa da Pimenteira I, 07°54'52.9"S, 38°18'02.5"W, 20 Oct 2017, *R.C. Silva & al. 60* (HUNEB) [Figs. 20A, 21A1, A2, 22A].

* *Senna uniflora* (Mill.) H.S.Irwin & Barneby

$2n = 24$, CHN. Brazil, Pernambuco, Serra Talhada, Mata da Pimenteira State Park, Lagoa da Pimenteira I, 07°54'52.9"S, 38°18'02.5"W, 20 Oct 2017, *R.C. Silva & al. 61* (HUNEB) [Figs. 20B, 21B, 22B].

Tribe Ingeae

Enterolobium timbouva Benth.

$2n = 26$, CHN. Brazil, Pernambuco, Serra Talhada, Federal Rural University of Pernambuco, Serra Talhada Academic Unit, 07°57'31.8"S, 38°17'27.6"W, 20 Oct 2017, *R.C. Silva & al. 65* (HUNEB) [Figs. 20C, 21C, 22C].

Mimosoid Clade

Tribe Mimoseae

* *Anadenanthera colubrina* (Vell.) Brenan

$2n = 24$, CHN. Brazil, Pernambuco, Serra Talhada, Federal Rural University of Pernambuco, Serra Talhada Academic Unit, 07°57'31.8"S, 38°17'37.6"W, 20 Oct 2017, *R.C. Silva & al. 66* (HUNEB) [Figs. 20D, 21D, 22D].

Desmanthus pernambucanus (L.) Thell.

$2n = 26$, CHN. Brazil, Pernambuco, Serra Talhada, Federal Rural University of Pernambuco, Serra Talhada Academic Unit, 07°57'31.8"S, 38°17'27.6"W, 20 Oct 2017, *R.C. Silva & al. 51* (HUNEB) [Figs. 20E, 21E, 22E].

Mimosa arenosa Poir.

$2n = 26$, CHN. Brazil, Bahia, Paulo Afonso, Raso da Catarina Ecological Station, 09°39'41.5"S, 38°27'27.1"W, 20 Dec 2017, *P.C.S.S.*

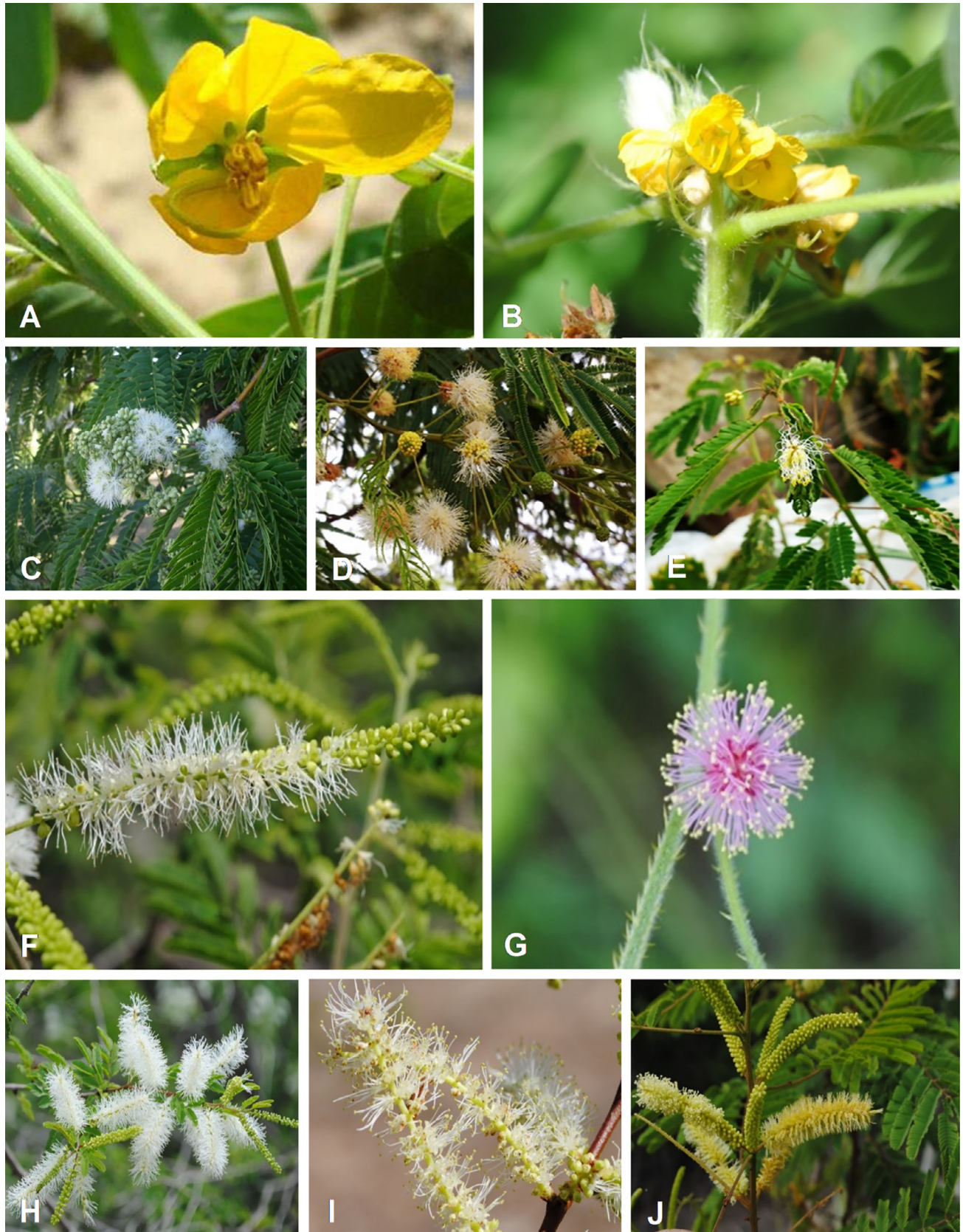


Fig. 20. Flowers of the analyzed species. **A**, *Senna obtusifolia*; **B**, *S. uniflora*; **C**, *Enterolobium timbouva*; **D**, *Anadenanthera colubrina*; **E**, *Desmanthus pernambucanus*; **F**, *Mimosa arenosa*; **G**, *M. candollei*; **H**, *M. ophthalmocentra*; **I**, *M. tenuiflora*; **J**, *Piptadenia stipulacea*. — Photos: André L. Melo (A, B, E–J); Géssica S. Santos (C, D).

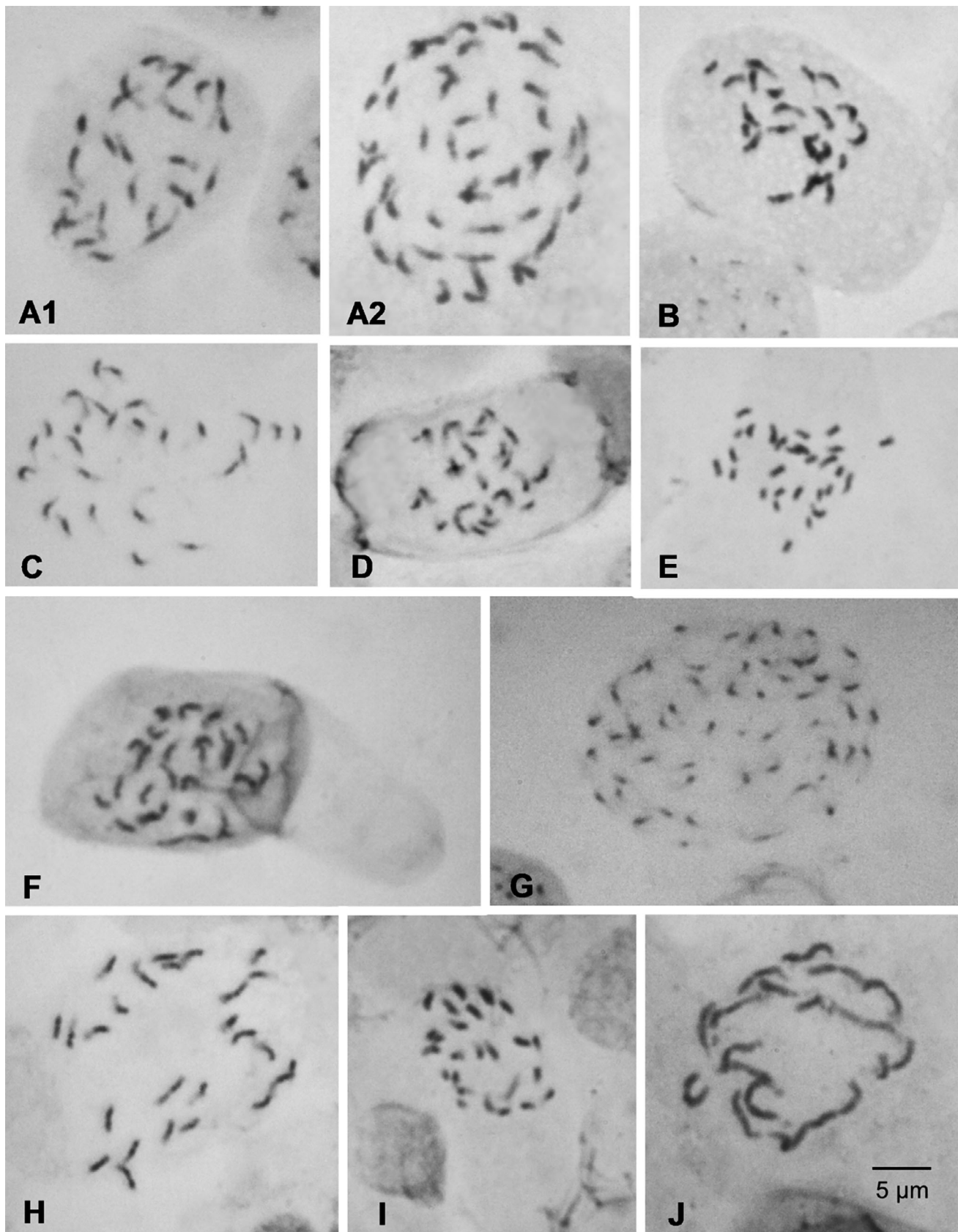


Fig. 21. Chromosome complements in species of Caesalpinioideae s.l. **A1 & A2**, *Senna obtusifolia*, $2n = 26$ and 52 ; **B**, *S. uniflora*, $2n = 24$; **C**, *Enterolobium timbouva*, $2n = 26$; **D**, *Anadenanthera colubrina*, $2n = 24$; **E**, *Desmanthus pernambucanus*, $2n = 26$; **F**, *Mimosa arenosa*, $2n = 26$; **G**, *M. candollei*, $2n = 52$; **H**, *M. opthalmocentra*, $2n = 26$; **I**, *M. tenuiflora*, $2n = 26$; **J**, *Piptadenia stipulacea*, $2n = 18$. — Scale bar = $5\ \mu\text{m}$.

Souza & al. 14 (HUNEB) [Figs. 20F, 21F, 22F]; Brazil, Pernambuco, Serra Talhada, Mata da Pimenteira State Park, Lagoa da Pimenteira II, 07°53'45.8"S, 38°18'19.3"W, 18 Dec 2017, *R.C. Silva & al. 74* (HUNEB).

Mimosa candollei R.Grether

$2n = 52$, CHN. Brazil, Pernambuco, Serra Talhada, Federal Rural University of Pernambuco, Serra Talhada Academic Unit, 07°57'31.8"S, 38°17'27.6"W, 18 Dec 2017, *R.C. Silva & al. 76* (HUNEB) [Figs. 20G, 21G, 22G].

Mimosa ophthalmocentra Mart. ex Benth.

$2n = 26$, CHN. Brazil, Pernambuco, Serra Talhada, Mata da Pimenteira State Park, Lagoa da Pimenteira II, 07°53'45.8"S, 38°18'19.3"W, 18 Dec 2017, *R.C. Silva & al. 69* (HUNEB) [Figs. 20H, 21H, 22H].

Mimosa tenuiflora (Willd.) Poir.

$2n = 26$, CHN. Brazil, Bahia, Paulo Afonso, Raso da Catarina Ecological Station, 09°39'38.4"S, 38°27'42.7"W, 20 Dec 2017, *P.C.S.S. Souza & al. 12* (HUNEB) [Figs. 20I, 21I, 22I]; Brazil, Pernambuco, Serra Talhada, Mata da Pimenteira State Park, Lagoa da

Pimenteira II, 07°53'45.8"S, 38°18'19.3"W, 18 Dec 2017, *R.C. Silva & al. 75* (HUNEB).

* *Piptadenia stipulacea* (Benth.) Ducke

$2n = 18$, CHN. Brazil, Pernambuco, Serra Talhada, Mata da Pimenteira State Park, Lagoa da Pimenteira II, 07°53'45.8"S, 38°18'19.3"W, 20 Oct 2017, *R.C. Silva & al. 73* (HUNEB) [Figs. 20J, 21J, 22J].

Caesalpinioideae is the second-largest legume subfamily, including approximately 4400 species and 48 genera with pantropical distribution (LPWG, 2017). This group is quite representative of caatinga, a biome exclusive to Brazil and characterized by semiarid climate, low average rainfall, rainfall seasonality, and strong endemism (Sampaio, 1995; Queiroz & al., 2009). This subfamily is little known cytologically, and chromosomal data for species endemic to, or occurring in, caatinga are incipient (Biondo & al., 2005; Santos & al., 2012). In this study, 7 of the 10 species analyzed corroborated literature data, while the numbers observed in *Senna uniflora*, *Anadenanthera colubrina*, and *Piptadenia stipulacea* are new records for these taxa. The species presented semireticulated

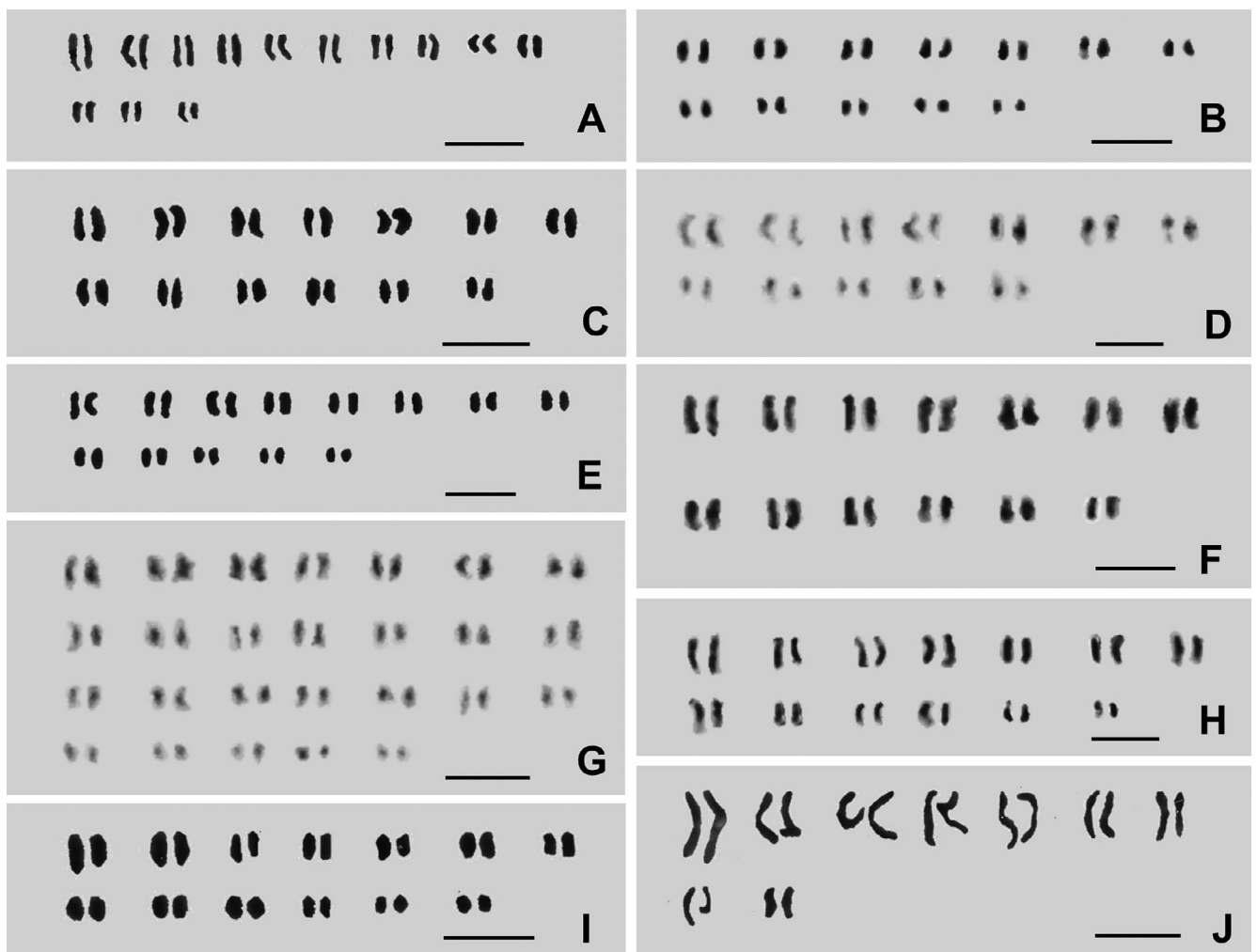


Fig. 22. Karyograms of species of the tribes Cassieae, Ingeae, and Mimoseae. **A**, *Senna obtusifolia*, $2n = 26$; **B**, *S. uniflora*, $2n = 24$; **C**, *Enterolobium timbouva*, $2n = 26$; **D**, *Anadenanthera colubrina*, $2n = 24$; **E**, *Desmanthus pernambucanus*, $2n = 26$; **F**, *Mimosa arenosa*, $2n = 26$; **G**, *M. candollei*, $2n = 52$; **H**, *M. ophthalmocentra*, $2n = 26$; **I**, *M. tenuiflora*, $2n = 26$; **J**, *Piptadenia stipulacea*, $2n = 18$. — Scale bars = 5 μ m.

interphase nuclei and proximal prophase condensation, which are stable characteristics of the family.

The genus *Senna* Mill. comprises about 300 species (Lewis & al., 2005), and only 20% of it have chromosomal records, restricted to one or a few populations. Chaulagain & Sakya (2002) and Cordeiro & Felix (2018) indicated that intra- and interspecific karyotypic variation in the genus is quite recurrent. The number $2n = 26$ observed in *S. obtusifolia* corroborates almost all counts for the species, differing only from $2n = 28$, observed by Ma & al. (1985) and Zhang (1992). This numerical variation may be due to taxonomic issues, since species previously defined as *Cassia tora* L., *C. obtusifolia* L., and *Senna tora* (L.) Roxb. were synonymized as *S. obtusifolia*. Brenan (1958) pointed to differences in the geography and morphology of these taxa. Species currently designated as *S. obtusifolia* are differentiated mainly in relation to habit, physiology, and chromosome number. Single-glanded individuals, frequent in the West Indies and southeastern United States, have the gametic number $n = 14$, while those occurring in English Guyana and Venezuela have two glands, lower habit, and $n = 13$ (Irwin & Turner, 1960).

Therefore, studies that include individuals from different populations are important to understand whether this numerical polymorphism is related or not to the taxonomic position of the species. For *Senna uniflora*, the number $2n = 24$, the second count for the species, differs from $n = 13$, observed by Irwin & Turner (1960). It is noteworthy that these authors did not photographically record the chromosomes of this species. At that time, *S. uniflora* was still taxonomically designated as *Cassia uniflora* belonging to the *C.* subg. *Senna* sect. *Prososperma*, along with *C. obtusifolia*. Our data corroborate the hypothesis of dysploidy events in the karyotypic evolution of the genus.

In Caesalpinioideae, it is commonly observed the simultaneous presence of diploid and polyploid cells in the same individual, a

phenomenon known as polysomaty. The origin and function of this mechanism are not well known. However, some authors point to the amplification of genes responsible for the synthesis of substances as a way to minimize energy expenditure or to favor the growth of cells and tissues in a shorter period of time (Leitch, 2000; Castro & al., 2007). In this study, one of the samples of *S. obtusifolia* showed polysomaty, with $2n = 26$ and 52. These numbers were also observed by Matos & al. (unpub.) for the species, as well as by other authors for other representatives of the genus (e.g., Resende & al., 2013).

Enterolobium Mart., in turn, has 11 species (Lewis & al., 2005). There are chromosomal records for four of them: *E. contortisiliquum* (Vell.) Morong, *E. cyclocarpum* (Jacq.) Griseb., *E. gummiferum* (Mart.) J.F.Macbr., and *E. timbouva*, all with $2n = 26$ (Darlington & Wylie, 1955; Tixier, 1965; Bawa, 1973; Bandel, 1974; Gibbs & Ingram, 1982; Huang & al., 1989; Santos & al., 2012), suggesting numerical karyotype stability for the genus and $x = 13$ as the basic number.

Some authors suggest polyploidy as the main mechanism of karyotypic evolution for the groups that currently make up the mimosoid clade (Poggio & al., 2008). Dahmer & al. (2011) analyzed 83 *Mimosa* species occurring in Brazil, Mexico, and Nepal, and observed that one-quarter of them had polyploid chromosome numbers. Seijo & Fernández (2001) also recorded similar proportions for the genus. Rodrigues & al. (2017) analyzed 11 *Mimosa* species occurring in the semiarid of the Raso da Catarina Ecoregion in Bahia State, Brazil. Four of them presented a polyploid chromosome number ($2n = 52$). Of these, two had polysomaty: *M. misera* Benth. and *M. piscatorum* Barneby ($2n = 26, 52$).

In this study, we analyzed seven species belonging to four genera of the tribe Mimoseae. Of these, only *M. candollei* presented a polyploid chromosome number ($2n = 52$), confirming the only previous

Table 5. Chromosomal measurements on some species of Caesalpinioideae.

Species	Voucher	CTLH [μm]	Chromosome size [μm]	
			Max.	Min.
Cassiaea				
<i>Senna obtusifolia</i> (L.) H.S.Irwin & Barneby	<i>Melo, P.L.B.N. & al. 03</i>	22.14	2.20	1.24
	<i>Silva, R.C. & al. 60</i>	32.45	3.85	1.73
<i>Senna uniflora</i> (Mill.) H.S.Irwin & Barneby	<i>Silva, R.C. & al. 61</i>	21.77	2.63	1.02
Ingeae				
<i>Enterolobium timbouva</i> Benth.	<i>Silva, R.C. & al. 65</i>	29.51	3.86	1.24
Mimoseae				
<i>Anadenanthera colubrina</i> (Vell.) Brenan	<i>Silva, R.C. & al. 66</i>	24.39	2.44	1.12
<i>Desmanthus pernambucanus</i> (L.) Thell.	<i>Silva, R.C. & al. 51</i>	20.93	2.54	0.94
<i>Mimosa arenosa</i> (Willd.) Poir.	<i>Souza, P.C.S.S. & al. 14</i>	27.48	3.79	1.24
	<i>Silva, R.C. & al. 74</i>	37.18	4.95	1.94
<i>Mimosa candollei</i> R.Grether	<i>Silva, R.C. & al. 76</i>	34.79	2.12	0.70
<i>Mimosa ophthalmocentra</i> Mart. ex Benth.	<i>Silva, R.C. & al. 69</i>	34.56	3.98	0.88
<i>Mimosa tenuiflora</i> (Willd.) Poir.	<i>Souza, P.C.S.S. & al. 12</i>	26.16	2.44	1.34
	<i>Silva, R.C. & al. 75</i>	19.20	2.63	0.74
<i>Piptadenia stipulacea</i> (Benth.) Ducke	<i>Silva, R.C. & al. 73</i>	52.71	9.24	2.98

CTLH = total haploid set length.

record for the species (Dahmer & al., 2011). The number $2n = 26$ observed in *M. arenosa*, *M. ophthalmocentra*, and *M. tenuiflora* confirms previous counts, as well as the basic number $x = 13$, suggested in the literature for the genus (Dahmer & al., 2011; Santos & al., 2012; Freire & al., 2013; Rodrigues & al., 2017). In turn, the chromosome numbers $2n = 24$ and $2n = 18$ observed in *A. colubrina* and *P. stipulacea*, respectively, differ from the number reported in the literature for these species, $2n = 26$ (Gibbs & Ingram, 1982; Alves & Custódio, 1989; Ortolani & al., 2010; Santos, 2017), which may indicate new cytotypes originated from dysploidy processes from $x = 13$. Regarding *Piptadenia*, only *P. obliqua* (Pers.) J.F. Macbr. and *P. stipulacea* have records ($2n = 26$).

The number $2n = 26$ observed in *D. pernambucanus* confirms the data of Santos & al. (2012), being the only record for the species. Notwithstanding, for all three other species of the genus with known chromosome number, *Desmanthus acuminatus* Benth., *D. illinoensis* (Michx.) MacMill., and *D. virgatus* (L.) Willd., all counts are $2n = 28$ (Turner & Beaman, 1953; Smith-White & al., 1963; Yeh & al., 1986; Kappali & Patil, 1987; Rice & al., 2015). Santos & al. (2012) suggested a secondary basic number for the genus, $x_2 = 14$, possibly resulting from ascending dysploidy from the primary basic number, $x_1 = 13$.

Studies with chromosome measurements in Caesalpinioideae are incipient. According to Heslop-Harrison & Schwarzacher (2011), different values of total haploid set length (CTLH) indicate a possible variation in DNA content, since the amount of chromatin in a given species is related to the size of its genome. For example, Oliveira (2011) observed coincident values of DNA and CTLH in *Euterpe* Mart. (Arecaceae) species. In this sense, this study performed chromosome measurements and calculated the CTLH of the 10 species analyzed (Table 5), also constructing their karyograms (Fig. 22). *Piptadenia stipulacea* had the highest CTLH (52.71 μm), and *Mimosa tenuiflora* had the lowest one (19.20 μm). Regarding chromosome length variation, *P. stipulacea* showed the largest amplitude (9.24 μm) and *M. candollei* showed the smallest one (0.70 μm). These data suggest that karyological analyses involving chromosome measurements associated with DNA content may contribute to better understand the evolution in Caesalpinioideae.

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IAPT chromosome data 33/15

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FABACEAE

Stylosanthes guianensis (Aubl.) Sw.

$2n = 20$, CHN. Argentina, Corrientes, Dept. Ituzaingo, 27°37'59.988"S, 56°51'25.991"W, 74 m, Dec 2016, *M.C. Silvestri, C.A. Acuña, G.I. Lavia & R.O. Vanni SALV3* (CTES); Argentina, Corrientes, Dept. Ituzaingo, 27°29'07.691"S, 56°05'03.479"W, 153 m, Dec 2016, *M.C. Silvestri, C.A. Acuña, G.I. Lavia & R.O. Vanni SALV4* (CTES) [Fig. 23A]; Argentina, Misiones, Dept. San Ignacio, 27°07'53.003"S, 55°30'20.98"W, Apr 2017, 136 m, *C.A. Acuña & M.C. Silvestri AS31* (CTES); Argentina, Misiones, Dept. San Ignacio, 27°16'40.007"S, 57°33'27.179"W, 132 m, Apr 2017, *C.A. Acuña & M.C. Silvestri AS31* (CTES).

Stylosanthes hippocampoides Mohlenbr.

$2n = 20$, CHN. Argentina, Corrientes, Dept. Berón de Astrada, 27°27'59.795"S, 57°28'15.383"W, 70 m, Dec 2016, *M.C. Silvestri, C.A. Acuña, G.I. Lavia & R.O. Vanni SALV1* (CTES); Argentina, Corrientes, Dept. Ituzaingo, 27°37'59.988"S, 56°51'25.991"W, 74 m, Dec 2016, *M.C. Silvestri, C.A. Acuña, G.I. Lavia & R.O. Vanni SALV2* (CTES); Argentina, Corrientes, Dept. San Miguel, 27°54'33.984"S, 57°26'39.192"W, 77 m, Dec 2016, *M.C. Silvestri, C.A. Acuña, G.I. Lavia & R.O. Vanni SALV5* (CTES); Argentina, Corrientes, Dept. San Cosme, Santa Ana, 27°27'12.06"S, 58°38'29.328"W, 63 m, *M.C. Silvestri, C.A. Acuña & C. Peichotto SAP6* (CTES) [Fig. 23B]; Argentina, Corrientes, Dept. San Cosme, Santa Ana, 27°28'19.992"S, 58°39'47.988"W, 62 m, *C.A. Acuña A41* (CTES); Argentina, Corrientes, Dept. San Martín, Tres Cerros, 29°06'41.075"S, 56°55'07.896"W, 86 m, *Y. Perez P32* (CTES); Argentina, Corrientes, Dept. San Martín, Tres Cerros, 29°06'18.503"S, 56°56'08.412"W, 86 m, *Y. Perez P34* (CTES); Argentina, Corrientes, Dept. Empedrado, 27°57'13.895"S, 58°49'01.091"W, 21 m, Sep 2018, *M.C. Silvestri, C.A. Acuña & G.I. Lavia SAL7* (CTES).

Stylosanthes Sw. (Papilionoideae, Fabaceae) is a tropical and subtropical genus with ~48 species that include important forage species (Mohlenbrock, 1957; Costa & Ferreira, 1984; Mannetje, 1984). Vanni (2017) described 23 taxa from South America, 11 of them are diploid ($2n = 2x = 20$), 8 are tetraploid ($2n = 4x = 40$), and the ploidy level of the remaining species is unknown (Maass & Sawkins, 2004). Here we present chromosome counts of four and eight populations of *S. guianensis* and *S. hippocampoides*, respectively, in order to provide the basis for further studies. These are natural populations belonging to two provinces from northeastern Argentina. Methods

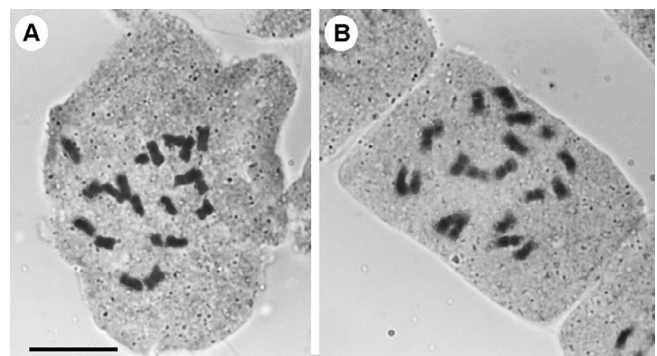


Fig. 23. Mitotic metaphases of *Stylosanthes* species ($2n = 20$). **A**, *S. guianensis*, $2n = 20$ (*M.C. Silvestri, C.A. Acuña, G.I. Lavia & R.O. Vanni SALV4*); **B**, *S. hippocampoides*, $2n = 20$ (*M.C. Silvestri, C.A. Acuña & C. Peichotto SAP6*). — Scale bar = 10 μ m.

for chromosome counts have been carried out according to Fernández & Krapovickas (1994).

Chromosome numbers $2n = 2x = 20$ detected in this study confirm data previously reported for *S. hippocampoides* by Franco & al. (2020), and for *S. guianensis* from Brazil populations (Vieira & al., 1993; Franco & al., 2020). For the first time, we report chromosome data for these species from Argentina. These data contribute to the characterization of natural populations of forage *Stylosanthes* species from northeastern Argentina (Silvestri & al., 2020).

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IAPT chromosome data 33/16

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* First chromosome count for the species.

POACEAE

Dactylis glomerata L.

$n = 7$, CHN. India, Uttarakhand, Uttarkashi, Assi Ganga Valley, Dharkot, 30°51'13"N, 78°30'34"E, 2500 m, river side slopes, 29 Jul 2017, *Jaswant Singh 36533* (PUN); India, Uttarakhand, Uttarkashi, Bhagirathi Valley, Gangotri, 31°06'36"N, 79°00'04"E, 3100 m, 8 Jul 2014, *Jaswant Singh 36574* (PUN); India, Uttarakhand, Uttarkashi, Bhagirathi Valley, Harsil, 31°02'20"N, 78°44'37"E, 2500 m, mountainous plains, 20 Jun 2015, *Jaswant Singh 36618* (PUN); India, Uttarakhand, Uttarkashi, Har Ki Dun Valley, on the way to Kalkati Dhar, 31°07'50"N, 78°23'06"E, 3200 m, bugyal, 7 Sep 2014, *Jaswant Singh 36604* (PUN); India, Uttarakhand, Uttarkashi, Har Ki Dun Valley, Osla, 31°07'06"N, 78°20'47"E, 2800 m, 18 Jun 2014, *Jaswant Singh 33943* (PUN); India, Uttarakhand, Uttarkashi, Har Ki Dun Valley, Renugaad, 31°07'36"N, 78°22'25"E, 2950 m, 18 Jun 2014, *Jaswant Singh 33967* (PUN); India, Uttarakhand, Uttarkashi, Yamuna Valley, Kharsali, 30°59'44"N, 78°27'59"E, 2550 m, on mountain slope, 17 Jun 2015, *Jaswant Singh 36616* (PUN); India, Uttarakhand, Uttarkashi, Yamuna Valley, Phool Chatti, 31°57'42"N, 78°25'48"E, 2400 m, 18 Jun 2015, *Jaswant Singh 36617* (PUN) [Fig. 24A–C].

$n = 7 + 0-1B$, CHN. India, Uttarakhand, Uttarkashi, Bhagirathi Valley, on the way to Bhojwasa, 30°57'41"N, 79°02'30"E, 3700 m, river side slopes, 11 Jul 2014, *Jaswant Singh 36587* (PUN); India, Uttarakhand, Uttarkashi, Bhagirathi Valley, Chirwasa, 30°58'53"N, 79°01'33"E, 3600 m, 11 Jul 2014, *Jaswant Singh 33945* (PUN); India, Uttarakhand, Uttarkashi, Har Ki Dun Valley, Har Ki Dun, 31°09'07"N, 78°25'54"E, 3450 m, 19 Jun 2014, *Jaswant Singh 33944* (PUN) [Fig. 24F,G].

This species has a gametic chromosome number of $n = 7$, as confirmed by the presence of 7 bivalents in the meiocytes at diakinesis (Fig. 24A), M I (Fig. 24B) and equal distribution of 7:7 chromosomes at A I (Fig. 24C). In most of the meiocytes of all accessions, a regular set of bivalents was observed, but the few meiocytes from the Bhojwasa, Chirwasa and Har Ki Dun regions showed the presence of one B-chromosome at diakinesis (Fig. 24F) and M I (Fig. 24G). The major fraction of meiocytes depicted normal meiotic behaviour, only in a few of them, the non-synchronous disjunction of bivalents (Fig. 24D), presence of laggards (Fig. 24E) and micronuclei at T I were found. The accessions of this species possessed 86%–98% fertile pollen grains (Fig. 24H).

The present chromosome count of $n = 7$, is in agreement with the diploid counts with a basic number of $x = 7$, as recorded in the individuals growing in the regions of Jammu & Kashmir (Mehra & Sunder, 1969; Mehra & Remanandan, 1973; Mehra & Sharma, 1977a; Koul & Gohil, 1987, 1990, 1991), Himachal Pradesh (Kaur & al., 2011; Singhal & al., 2014; Singh & al., 2019), Meghalaya (Mehra, 1982) and West Bengal (Mehra & Sharma, 1977b) States of India. Due to its gregarious nature of occurrence over the native and introduced areas, species have been extensively explored for the chromosome number diversity from different regions of the globe, and a series of cytotypes harbouring individuals with aneuploid and euploid counts was recorded: $2n = 14 + 0-4B$, 26, 27, 28 + 0-4B, 29, 30, 35, 40, 41, 42 (Rice & al., 2015; Goldblatt & Johnson, 1979+).

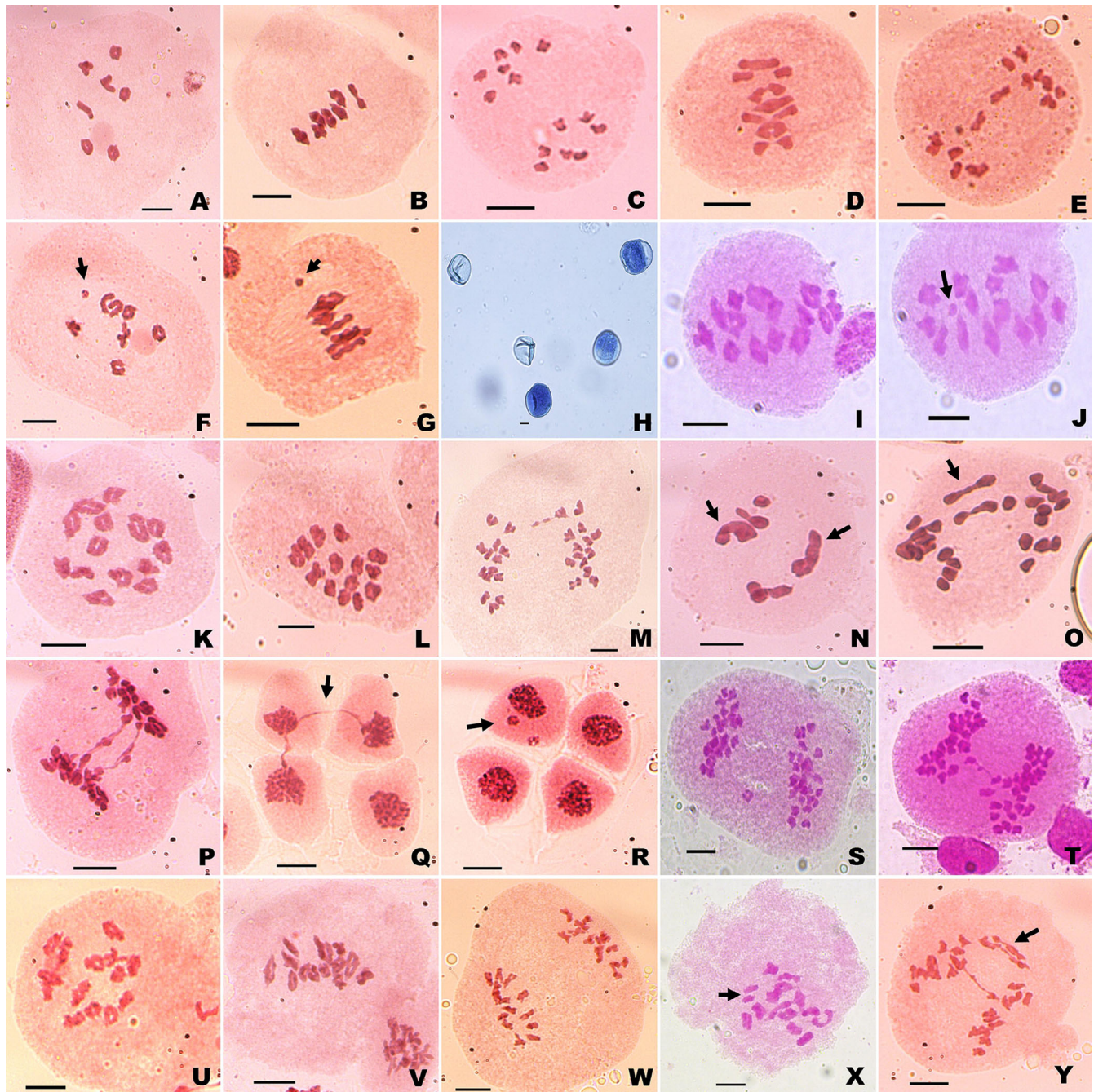


Fig. 24. A–H, Male meiotic course of *Dactylis glomerata*: A, Diakinesis meicyote showing 7 bivalents; B, Meicyote showing 7 bivalents at M I; C, Meicyote showing 7:7 chromosomes at each A I pole; D, Meicyote showing non-synchronous segregation of bivalents at M I; E, Meicyote depicting late migration of chromosomes at A I; F, Diakinesis meicyote showing the presence of a small-sized 1B chromosome (arrow); G, M I meicyote showing the presence of a small-sized 1B chromosome (arrow); H, Stained fertile and unstained sterile pollen grains. I & J, *Festuca alatavica*: I, Meicyote showing 14 bivalents at M I; J, Meicyote showing the presence of a small-sized 1B chromosome at M I (arrow). K–R, *Festuca gigangtea*: K, Diakinesis meicyote showing 14 bivalents; L, Meicyote showing 14 bivalents at M I; M, Meicyote showing 14:14 chromosomes at each A I pole; N, Meicyote depicting chromatin stickiness at M I (arrows); O, Meicyote showing non-synchronous segregation of bivalents at M I (arrow); P, Meicyote showing late disjunction created chromatin bridge at A I; Q, Tetrad microspore subunits showing late disjunction created chromatin bridges (arrow); R, Tetrad microspore subunit with micronuclei (arrow). S & T, *Festuca rubra*: S, Meicyote 28:28 chromosome distribution at A I; T, Meicyote showing late disjunction at A I. U–Y, *Festuca valesiaca*: U, Diakinesis meicyote showing 14 bivalents; V, Meicyote showing 14 bivalents at M I; W, Meicyote showing 14:14 chromosomes at each A I pole; X, Meicyote showing early disjunction of bivalents at M I depicted by $13_{II} + 2_I$ (arrow); Y, Meicyote showing late disjunction created chromatin bridges (arrow). — Scale bars = 10 μ m.

* *Festuca alata* (Hack. ex St.-Yves) Roshev.

$n = 14 + 0-1B$, CHN. India, Uttarakhand, Uttarkashi, Har Ki Dun Valley, Morinda Lake, 31°10'00"N, 78°25'42"E, 3800 m, alpine meadow, 1 Jun 2016, *Jaswant Singh 36651* (PUN) [Fig. 24I,J].

The study of an accession growing along the water channel in the Morinda Lake region shows that this species has a gametic chromosome number of $n = 14$. There were 14 bivalents in the meiocytes at M I (Fig. 24I). Frequently, the M I meiocytes of studied accession also possessed one B-chromosome (Fig. 24J). This accession had 90% fertile pollen grains. The tetraploid chromosome count, $n = 14 + 0-1B$ with a basic number of $x = 7$, is the first record for the species.

Festuca gigantea (L.) Vill.

$n = 14$, CHN. India, Uttarakhand, Uttarkashi, Assi Ganga Valley, Dodital, 30°53'54"N, 78°31'30"E, 3000 m, 31 Jul 2015, *Jaswant Singh 33925* (PUN); India, Uttarakhand, Uttarkashi, Barkot Valley, Orcha Band, 30°48'33"N, 78°13'52"E, 1600 m, 16 Aug 2014, *Jaswant Singh 35276* (PUN); India, Uttarakhand, Uttarkashi, Chaurangi Khal Forests, on the way to Chaurangi Khal, 30°39'01"N, 78°29'21"E, 2250 m, 6 Sep 2015, *Jaswant Singh 36644* (PUN); India, Uttarakhand, Uttarkashi, Chaurangi Khal Forests, Chaurangi Khal, 30°38'38"N, 78°29'19"E, 2300 m, 6 Sep 2015, *Jaswant Singh 33934* (PUN); India, Uttarakhand, Uttarkashi, Chaurangi Khal Forests, on the way to Nachiketa Tal, 30°38'30"N, 78°28'30"E, 2400 m, 9 Sep 2013, *Jaswant Singh 36549* (PUN); India, Uttarakhand, Uttarkashi, Har Ki Dun Valley, on the way to Dhatmeer, 31°05'07"N, 78°16'04"E, 2100 m, 16 Jun 2014, *Jaswant Singh 36572* (PUN); India, Uttarakhand, Uttarkashi, Har Ki Dun Valley, on the way to Gangarh, 31°06'24"N, 78°18'35"E, 2300 m, 4 Sep 2014, *Jaswant Singh 36598* (PUN); India, Uttarakhand, Uttarkashi, Har Ki Dun Valley, on the way to Taluka, 31°04'48"N, 78°14'52"E, 2000 m, 4 Sep 2014, *Jaswant Singh 36602* (PUN); India, Uttarakhand, Uttarkashi, Rarhi Valley, on the way to Rarhi, 30°45'58"N, 78°15'17"E, 2150 m, 9 Aug 2014, *Jaswant Singh 36594* (PUN); India, Uttarakhand, Uttarkashi, Rarhi Valley, Rarhi Top, 30°45'58"N, 78°15'17"E, 2250 m, 9 Aug 2014, *Jaswant Singh 36592* (PUN) [Fig. 24K–M].

The analysed individuals of this species have a gametic chromosome number $n = 14$. There were 14 bivalents in the meiocytes at diakinesis (Fig. 24K) and M I (Fig. 24L) and an equal distribution of 14:14 chromosomes at each A I pole (Fig. 24M). During the meiosis, a few of the meiocytes had non-synchronous disjunction of bivalents. The meiocytes of Rarhi accessions had chromatin stickiness, observed in the form of chromatin mass at diakinesis, M I (Fig. 24N) and A I. The non-synchronous disjunction of bivalents (Fig. 24O) was observed as chromatin bridges in the meiocytes at A I (Fig. 24P). In the accessions of the Dhatmeer, Gangarh and Taluka regions in the Har Ki Dun Valley, the formation of chromatin bridges at the latter stages, as at A II and in tetrad microspores was observed (Fig. 24Q). The non-synchronous disjunction created laggards ultimately leading to the formation of micronuclei in the dyad and tetrad microspore subunits (Fig. 24R). There were 90%–100% fertile pollen grains in the accessions of this species.

The chromosome number of $n = 7$ is in agreement with the number previously recorded in plant accessions from the Kashmir (Mehra & al., 1968; Mehra & Sunder, 1969) and West Bengal (Mehra & Sharma, 1975; Mehra, 1982) regions of India. The previously recorded chromosome number diversity for this species shows that the individuals harbour four cytotypes, viz. $2x$, $4x$, $6x$, and $8x$ with a chromosome number of $2n = 14, 28, 42$, and 56 , respectively (Rice & al., 2015; Goldblatt & Johnson, 1979+).

Festuca rubra L.

$n = 28$, CHN. India, Uttarakhand, Uttarkashi, Har Ki Dun Valley, Kalkati Dhar, 30°59'44"N, 78°27'59"E, 3300 m, 13 Aug 2016, *Jaswant Singh 36673* (PUN) [Fig. 24S,T].

The study of the accession from the Kalkati Dhar region shown the presence of a gametic chromosome count of $n = 28$. There were 28:28 chromosomes at each A I pole (Fig. 24S). The meiotic course was normal, but a few meiocytes were observed with non-synchronous disjunction of bivalents (Fig. 24T). This accession had 90% fertile pollen grains.

The present chromosome number of $n = 28$ is in agreement with previously recorded counts in accessions from other Himalayan localities (Mehra & Sood, 1976; Ghorai & Sharma, 1981; Mehra, 1982). The previously recorded chromosome numbers from accessions of this species from different regions of Asia, Europe and North America shows that it is a polyploid complex of euploids and aneuploids, with $2n = 14, 28, 35, 42, 44, 48, 49, 54, 56, 63, 64$ and 70 (Rice & al., 2015; Goldblatt & Johnson, 1979+).

Festuca valesiaca Schleich. ex Gaudin

$n = 14$, CHN. India, Uttarakhand, Uttarkashi, Bhagirathi Valley, Bhaironghati, 31°00'32"N, 78°52'48"E, 2800 m, 20 Jun 2015, *Jaswant Singh 36665* (PUN); India, Uttarakhand, Uttarkashi, Bhagirathi Valley, Bhojwasa, 30°56'56"N, 79°03'07"E, 3750 m, 11 Jul 2014, *Jaswant Singh 33911* (PUN); India, Uttarakhand, Uttarkashi, Bhagirathi Valley, Chirwasa, 30°58'53"N, 79°01'33"E, 2800 m, 22 Jun 2016, *Jaswant Singh 36672* (PUN); India, Uttarakhand, Uttarkashi, Bhagirathi Valley, Gangotri, 31°06'36"N, 79°00'04"E, 3100 m, 26 May 2014, *Jaswant Singh 36570* (PUN); India, Uttarakhand, Uttarkashi, Jadh Ganga Valley, Nelong, 31°06'36"N, 79°00'04"E, 3500 m, 20 Jun 2015, *Jaswant Singh 36646* (PUN); India, Uttarakhand, Uttarkashi, Har Ki Dun Valley, on the way to Kalkati Dhar, 30°07'50"N, 78°22'49"E, 3100 m, 18 Jun 2014, *Jaswant Singh 33947* (PUN); India, Uttarakhand, Uttarkashi, Har Ki Dun Valley, on the way to Morinda Lake, 31°09'49"N, 78°25'41"E, 3750 m, 1 Jun 2016, *Jaswant Singh 36663* (PUN); India, Uttarakhand, Uttarkashi, Har Ki Dun Valley, Morinda Lake, 31°10'00"N, 78°25'42"E, 3800 m, 1 Jun 2016, *Jaswant Singh 36650* (PUN) [Fig. 24U–W].

The gametic chromosome number of $n = 14$ for this species was ascertained from the presence of 14 bivalents in the meiocytes at diakinesis (Fig. 24U) and M I (Fig. 24V), and equal distribution of 14:14 chromosomes at each A I pole (Fig. 24W). Further, during the meiotic course, a few meiocytes had non-synchronous disjunction of bivalents (Fig. 24X,Y). The accessions of this species had mostly 80%–94% fertile pollen grains. In a few diakinesis meiocytes from the Nelong region of the Jadh Ganga Valley accession, the migration of chromatin material among neighbouring meiocytes through cytotoxic channels was observed. This accession had 75% fertile pollen grains.

The chromosome number of $n = 14$ is in agreement with previously recorded counts in individuals of this species growing in the Aporwot region of Kashmir Himalaya, India (Mehra & Remanandan, 1973; Mehra & Sharma, 1977a) and European accessions (Bulgaria: Kozuharov & Petrova, 1991; Hungary: Felföldy, 1947). Previously recorded chromosome counts of $2n = 14, 28$ and 42 infer that this species is a polyploid complex of $2x, 4x$ and $6x$ cytotypes with a basic number of $x = 7$ (Rice & al., 2015; Goldblatt & Johnson, 1979+).

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IAPT chromosome data 33/17

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- * First chromosome count for the species.
- ** New chromosome number for the species.
- # Species with intra-specific cytotype variation.

LYTHRACEAE

Cuphea P.Brown subg. Cuphea

Cuphea circaeoides Sm. ex Sims (*C.* sect. *Archocuphea* Koehne) 2n = 22, CHN. Brazil, Paraíba, Serra Branca, 07° 12'38"S, 36° 10'32"W, 20 Apr 2018, J.M.P. Cordeiro 1326 (EAN) [Figs. 25C, 26I].

Cuphea racemosa (L.f.) Spreng. (*C.* sect. *Cuphea*)

** n = 8, CHN. Brazil, Rio Grande do Sul, Caxias do Sul, 28° 49' 42"S, 51° 00' 25"W, 26 Nov 2014, T.B. Cavalcanti 3879 (CEN).

Cuphea subg. Bracteolatae S.A.Graham

Cuphea acinos A.St.-Hil. (*C.* sect. *Euandra* Koehne)

** n = 8, CHN. Brazil, Minas Gerais, Itacambira, 17° 15' 00"S, 43° 05' 13"W, 5 Feb 2015, T.B. Cavalcanti 3904 (CEN) [Figs. 25A, 26A].

Cuphea brachiata Mart. ex Koehne (*C.* sect. *Trispermum* Koehne)

** n = 8, CHN. Brazil, Minas Gerais, Itacambira, 17° 15' 00"S, 43° 05' 13"W, 5 Feb 2015, T.B. Cavalcanti 3903 (CEN).

Cuphea calophylla var. *mesostemon* (Koehne) S.A.Graham

(*C.* sect. *Brachyandra* Koehne)

n = 8, CHN. Brazil, Santa Catarina, Canoinhas, 26° 07' 56"S, 50° 18' 39"W, 23 Nov 2014, T.B. Cavalcanti 3865 (CEN).

Cuphea campestris Mart. ex Koehne (*C.* sect. *Euandra* Koehne)

2n = 16, CHN. Brazil, Paraíba, Serra Branca, 07° 29' 09"S, 36° 40' 47"W, 19 Apr 2018, J.M.P. Cordeiro 1272 (EAN) [Figs. 25B, 26H].

Cuphea confertiflora A.St.-Hil. (*C.* sect. *Euandra* Koehne)

n = 9, CHN. Brazil, Paraná, Guarapuava, 25° 30' 09"S, 51° 32' 43"W, 20 Nov 2014, T.B. Cavalcanti 3855 (CEN).

Cuphea disperma Koehne (*C.* sect. *Euandra* Koehne)

n = 7, CHN. Brazil, Minas Gerais, Monjolos, 18° 18' 06"S, 43° 59' 54"W, 7 Feb 2015, T.B. Cavalcanti 3921 (CEN); Brazil, Minas Gerais, Couto de Magalhães de Minas, 18° 07' 46"S, 43° 30' 56"W, 9 Feb 2015, T.B. Cavalcanti 3931 (CEN).

Cuphea ericoides Cham. & Schltdl. (*C.* sect. *Trispermum* Koehne)

** n = 8, CHN. Brazil, Pernambuco, Buíque, 08° 35' 29"S, 37° 12' 17"W, 8 May 2018, G. Pereira-Silva 17190 (CEN); Brazil, Pernambuco, Buíque, 08° 33' 20"S, 37° 12' 25"W, 8 May 2018,

G. Pereira-Silva 17191 (CEN); Brazil, Minas Gerais, Itacambira, 17°04'58"S, 43°18'41"W, 5 Feb 2015, *T.B. Cavalcanti 3905* (CEN).

Cuphea flava Spreng. (*C. sect. Trispermum* Koehne)

* $2n = 16$, CHN. Brazil, Paraíba, Mamanguape, 06°44'32"S, 35°08'31"W, 1 Jan 2018, *J.M.P. Cordeiro 1332* (EAN) [Figs. 25D, 26J].

Cuphea glutinosa Cham. & Schldl. (*C. sect. Euandra* Koehne)

** $n = 13$, CHN. Brazil, Santa Catarina, Santa Cecília, 25°30'09"S, 51°32'43"W, 23 Nov 2014, *T.B. Cavalcanti 3867* (CEN).

$n = 16$, CHN. Brazil, Paraná, Guarapuava, 25°30'09"S, 51°32'43"W, 20 Nov 2014, *T.B. Cavalcanti 3854* (CEN).

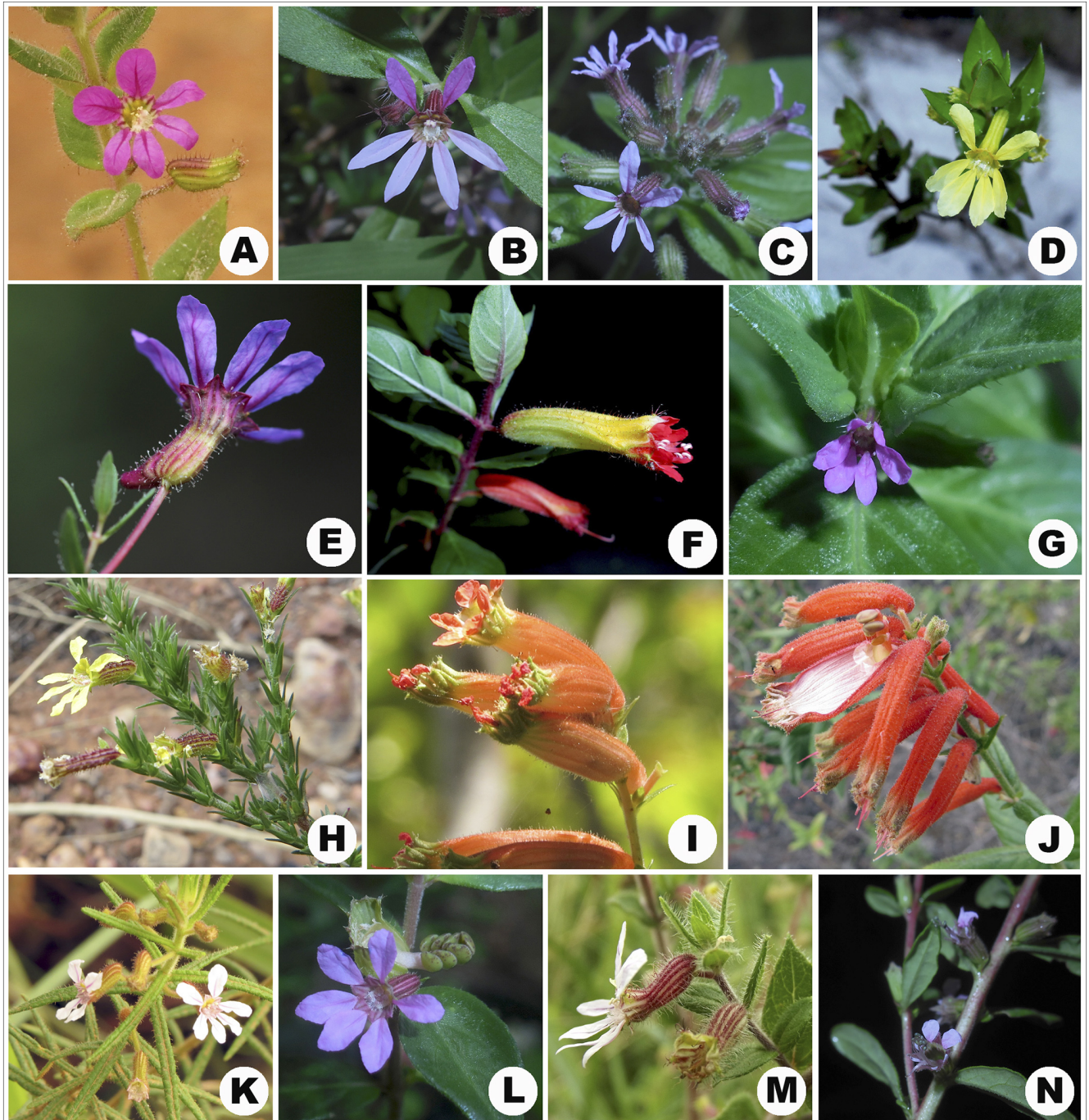


Fig. 25. Lythraceae, representative species of *Cuphea* and *Pleurophora*: **A**, *Cuphea acinos*; **B**, *C. campestris*; **C**, *C. circaeoides*; **D**, *C. flava*; **E**, *C. linifolia*; **F**, *C. loefgrenii*; **G**, *C. micrantha*; **H**, *C. paralarix*; **I**, *C. pulchra* var. *corollata*; **J**, *C. pulchra* var. *pulchra*; **K**, *C. sperguloides*; **L**, *C. strigulosa*; **M**, *C. urbaniana*; **N**, *Pleurophora anomala*. — Photos: **A** & **K**: Taciana Barbosa Cavalcanti; **B–D**, **F**, **G**, **L** & **N**: Joel M.P. Cordeiro; **E**: Sérgio Bordignon; **H–J** & **M**: Marlon Garlet Facco.

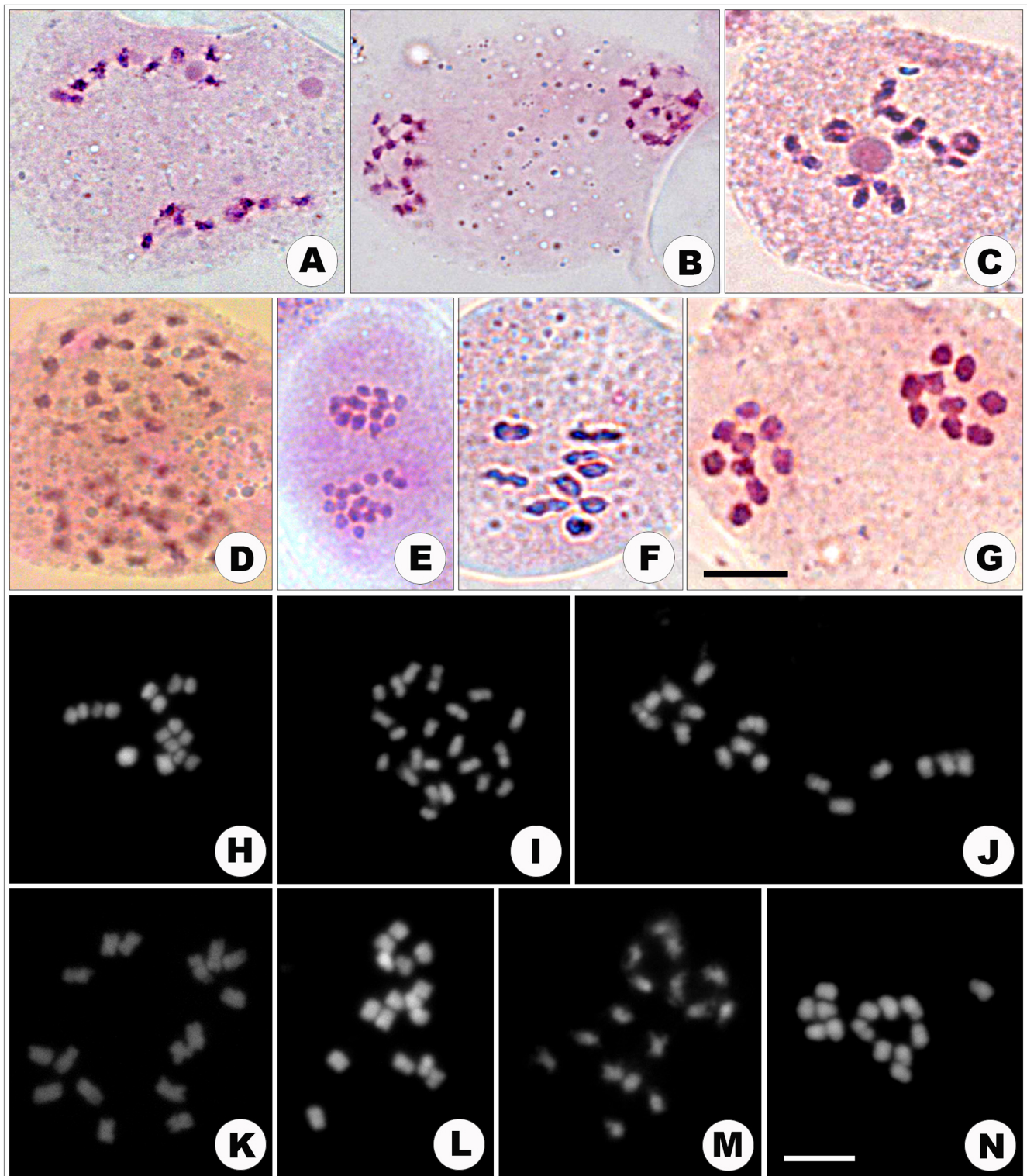


Fig. 26. Meiotic (A–G) and mitotic cells (H–M) of *Cuphea*, and mitotic cells of *Pleurophora anomala* (N) (Lythraceae). A, *Cuphea acinos* ($n = 8$); B, *Cuphea linifolia* ($n = 16$); C, *Cuphea paralarix* ($n = 8$); D, *Cuphea pulchra* var. *corollata* ($n = 24$); E, *Cuphea pulchra* var. *pulchra* ($n = 16$); F, *Cuphea sperguloidea* ($n = 9$); G, *Cuphea urbaniana* ($n = 9$); H, *Cuphea campestris* ($2n = 16$); I, *Cuphea circaeoides* ($2n = 22$); J, *Cuphea flava* ($2n = 16$); K, *Cuphea loefgrenii* ($2n = 16$); L, *Cuphea micrantha* ($2n = 16$); M, *Cuphea strigulosa* ($2n = 16$); N, *Pleurophora anomala* ($2n = 14$). — Scale bars: G = 10 μm ; N = 5 μm .

- Cuphea inaequalifolia* Koehne (*C. sect. Trispermum* Koehne)
* $n = 8$, CHN. Brazil, Mato Grosso, Canarana, 13°37'11"S, 51°56'52"W, 5 Apr 2018, *G. Pereira-Silva 17056* (CEN); Brazil, Mato Grosso, Pedra Preta, 16°47'58"S, 54°10'17"W, 8 Apr 2018, *G. Pereira-Silva 17088* (CEN).
- # *Cuphea laricoides* Koehne (*C. sect. Trispermum* Koehne)
* $n = 16$, CHN. Brazil, Piauí, Piripiri, 04°25'41"S, 41°43'02"W, 5 May 2018, *G. Pereira-Silva 17184* (CEN).
* $n = 24$, CHN. Brazil, Piauí, Piracuruca, 04°06'11"S, 42°41'27"W, 6 May 2018, *G. Pereira-Silva 17180* (CEN).
- Cuphea linarioides* Cham. & Schltdl. (*C. sect. Euandra* Koehne)
** $n = 16$, CHN. Brazil, Rio Grande do Sul, Caxias do Sul, 28°52'25"S, 50°58'26"W, 26 Nov 2014, *T.B. Cavalcanti 3878* (CEN).
- # *Cuphea linifolia* (A.St.-Hil.) Koehne (*C. sect. Euandra* Koehne)
 $n = 9$, CHN. Brazil, Rio Grande do Sul, Caxias do Sul, 28°49'42"S, 51°00'25"W, 26 Nov 2014, *T.B. Cavalcanti 3880* (CEN).
 $n = 16$, CHN. Brazil, Paraná, Lapa, 24°21'18"S, 49°48'23"W, 19 Nov 2014, *T.B. Cavalcanti 3888* (CEN) [Figs. 25E, 26B].
- Cuphea loefgrenii* Bacig. (*C. sect. Melvilla* Koehne)
 $2n = 16$, CHN. Brazil, Piauí, Pedro II, 04°19'57"S, 41°26'48"W, 9 Apr 2018, *J.M.P. Cordeiro 1270* (EAN) [Figs. 25F, 26K].
* $n = 8$, CHN. Brazil, Piauí, Piracuruca, 04°05'21"S, 41°40'55"W, 6 May 2018, *G. Pereira-Silva 17183* (CEN); Brazil, Piauí, Pedro II, 04°19'35"S, 41°26'20"W, 6 May 2018, *G. Pereira-Silva 17188* (CEN).
- # *Cuphea lutescens* Pohl ex Koehne (*C. sect. Pseudocircaea* Koehne)
 $n = 7$, CHN. Brazil, Minas Gerais, Itacambira, 17°15'00"S, 43°03'32"W, 5 Feb 2015, *T.B. Cavalcanti 3898* (CEN); Brazil, Mato Grosso, Santo Antônio do Leverger, 15°49'01"S, 55°32'05"W, 8 Apr 2018, *G. Pereira-Silva 17090* (CEN).
** $n = 8$; Brazil, Minas Gerais, Itacambira, 17°04'47"S, 43°16'35"W, 5 Feb 2015, *T.B. Cavalcanti 3910* (CEN).
- Cuphea micrantha* Kunth (*C. sect. Trispermum* Koehne)
 $2n = 16$, CHN. Brazil, Paraíba, Sertãozinho, 06°44'06"S, 35°27'30"W, 6 Apr 2018, *J.M.P. Cordeiro 1269* (EAN); Brazil, Paraíba, Sertãozinho, 06°43'34"S, 35°26'42"W, 28 Apr 2018, *J.M.P. Cordeiro 1325* (EAN) [Figs. 25G, 26L].
- Cuphea odonellii* Lourteig (*C. sect. Trispermum* Koehne)
 $n = 8$, CHN. Brazil, Mato Grosso, Água Boa, 14°06'06"S, 52°10'21"W, 5 Apr 2018, *G. Pereira-Silva 17050* (CEN).
- Cuphea paralarix* (Lourteig) T.B.Cavalc. & S.A.Graham (*C. sect. Trispermum* Koehne)
* $n = 8$, CHN. Brazil, Minas Gerais, Itacambira, 17°04'47"S, 43°16'35"W, 5 Feb 2015, *T.B. Cavalcanti 3910a* (CEN); Brazil, Goiás, Alto Paraíso de Goiás, 14°13'40"S, 47°40'01"W, 2 Mar 2015, *T.B. Cavalcanti 3979* (CEN) [Figs. 25H, 26C].
- Cuphea pseudovaccinium* A.St.-Hil. (*C. sect. Euandra* Koehne)
 $n = 7$, CHN. Brazil, Minas Gerais, Joaquim Felício, 17°42'49"S, 44°11'30"W, 6 Feb 2015, *T.B. Cavalcanti 3911* (CEN).
- Cuphea pulchra* var. *corollata* T.B.Cavalc. & S.A.Graham (*C. sect. Trispermum* Koehne)
* $n = 24$, CHN. Brazil, Bahia, Miguel Calmon, 11°21'07"S, 40°30'10"W, 8 Aug 2016, *M.G. Facco 488* (CEN) [Figs. 25I, 26D].
- Cuphea pulchra* Moric. var. *pulchra* (*C. sect. Trispermum* Koehne)
** $n = 16$, CHN. Brazil, Bahia, Morro do Chapéu, 11°35'06"S, 41°12'22"W, 7 Aug 2016, *M.G. Facco 484* (CEN) [Figs. 25J, 26E].
- Cuphea rubrovirens* T.B.Cavalc. (*C. sect. Melvilla* Koehne)
* $n = 7$, CHN. Brazil, Minas Gerais, Itacambira, 17°04'47"S, 43°16'35"W, 5 Feb 2015, *T.B. Cavalcanti 3908* (CEN).
- Cuphea sessilifolia* Mart. (*C. sect. Trispermum* Koehne)
 $n = 8$, CHN. Brazil, Minas Gerais, Itacambira, 17°15'00"S, 43°05'13"W, 5 Feb 2015, *T.B. Cavalcanti 3902* (CEN).
 $n = 16$, CHN. Brazil, Mato Grosso, Água Boa, 14°18'40"S, 52°10'08"W, 5 Apr 2018, *G. Pereira-Silva 17048* (CEN).
- Cuphea sperguloides* A.St.-Hil. (*C. sect. Euandra* Koehne)
* $n = 9$, CHN. Brazil, Minas Gerais, Diamantina, 18°17'02"S, 43°58'51"W, 7 Feb 2015, *T.B. Cavalcanti 3924* (CEN) [Figs. 25K, 26F].
- Cuphea spermacoce* A.St.-Hil. var. *spermacoce* (*C. sect. Euandra* Koehne)
** $n = 16$, CHN. Brazil, Distrito Federal, Brasília, 15°54'53"S, 48°59'59"W, 6 Oct 2004, *T.B. Cavalcanti 3563* (CEN).
- Cuphea strigulosa* Kunth (*C. sect. Euandra* Koehne)
 $2n = 16$, CHN. Brazil, Paraíba, Areia, 06°58'12"S, 35°42'15"W, 3 Jun 2018, *J.M.P. Cordeiro 1372* (EAN) [Figs. 25L, 26M].
- Cuphea tuberosa* Cham. & Schltdl. (*C. sect. Euandra* Koehne)
** $n = 7$, CHN. Brazil, Paraná, Palmas, 26°29'40"S, 52°00'38"W, 21 Nov 2014, *T.B. Cavalcanti 3858* (CEN).
- # *Cuphea urbaniana* Koehne (*C. sect. Euandra* Koehne)
** $n = 9$, CHN. Brazil, Santa Catarina, Porto União, 26°16'55"S, 51°01'50"W, 22 Nov 2014, *T.B. Cavalcanti 3863* (CEN); Brazil, Santa Catarina, Correia Pinto, 27°32'12"S, 50°22'33"W, 24 Nov 2014, *T.B. Cavalcanti 3872* (CEN) [Figs. 25M, 26G].
 $n = 16$, CHN. Brazil, Santa Catarina, Santa Cecília, 26°46'46"S, 50°20'49"W, 23 Nov 2014, *T.B. Cavalcanti 3868* (CEN).
** $n = 18$, CHN. Brazil, Paraná, Palmas, 26°34'38"S, 51°44'57"W, 22 Nov 2014, *T.B. Cavalcanti 3859* (CEN); Brazil, Santa Catarina, Curitiba, 27°16'36"S, 50°26'16"W, 24 Nov 2014, *T.B. Cavalcanti 3870* (CEN).
- Pleurophora anomala* (A.St.-Hil.) Koehne
 $2n = 14$, CHN. Brazil, Paraíba, Serra da Raiz, 06°41'02"S, 35°26'23"W, 3 Mar 2018, *J.M.P. Cordeiro 1262* (EAN) [Figs. 25N, 26N].
- Chromosome counts were performed in meiotic cells (Singh, 2002) of young inflorescences fixed directly in the field and in mitotic cells from root tips obtained from cultivated plants, according to Guerra & Souza (2002).
- The chromosome numbers were determined in a large sample of species and accessions of *Cuphea* P.Browne from southeastern and

northeastern Brazil, including species with extensive variation in morphology, which presents problems in taxonomy. Forty-nine accessions were examined, including species from both subgenera and from 7 of 13 sections, in addition to one accession of *Pleurophora anomala*. In total, 31 taxa were counted, with chromosome numbers for eight species reported for the first time. The new counts expanded the variation in known chromosome numbers in 12 of the 31 taxa. Five species with intra-specific cytotype variation were reported, which demonstrates the importance of dysploidy and polyploidy in the karyotype evolution of *Cuphea*.

Cuphea is the largest and most complex genus of the family Lythraceae, with about 270 species, composed primarily of perennial herbs and subshrubs of tropical and subtropical regions of the Americas (Graham & al., 2006). For the family, with 28 genera and about 600 species, $x = 8$ is considered the basic chromosome number (Graham, 1989, 2007; Graham & Cavalcanti, 2001). The basic number is an important factor necessary for understanding the evolutionary mechanisms leading to species diversification in flowering plants (Soltis & Soltis, 2009; Soltis & al., 2015). Within the genus *Cuphea*, chromosome counts indicate that the changes in the chromosome number have been a significant force in speciation. There is a great variation in the chromosome numbers, some representing polyploid series, and other dysploids, differing by one or more chromosomes from either the diploid or a polyploid state (Graham & Cavalcanti, 2001). The basic number for the genus has been considered the same for the family, $x = 8$ (Tobe & al., 1986; Graham & al., 1993; Graham & Cavalcanti, 2001).

Cuphea is divided into two subgenera and 13 sections, according to the infrageneric classification established by Koehne (1877, 1903), which have been modified by subsequent studies (Lourteig, 1986, 1987; Graham & Cavalcanti, 2013; Graham, 2017, 2019). The paraphyly of most sections was demonstrated by the molecular analyzes of Graham & al. (2006) and Barber & al. (2010), and these studies provide support for the hypothesis that the genus split early in its phylogeny forming two main lineages equivalent to the two currently recognized subgenera. The same authors confirmed *Pleurophora* as sister of *Cuphea*.

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IAPT chromosome data 33/18

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* New cytotype for the species.

POACEAE

Paspalum L. group *Parviflora*

Paspalum clavuliferum C.Wright

$2n = 20$, CHN. Brazil, Goiás, Flores de Goiás, 15°54'46.7"S, 46°57'24.7"W, 18 Mar 2015, R.C. Oliveira & al. 3006 (UB) [Fig. 27C].

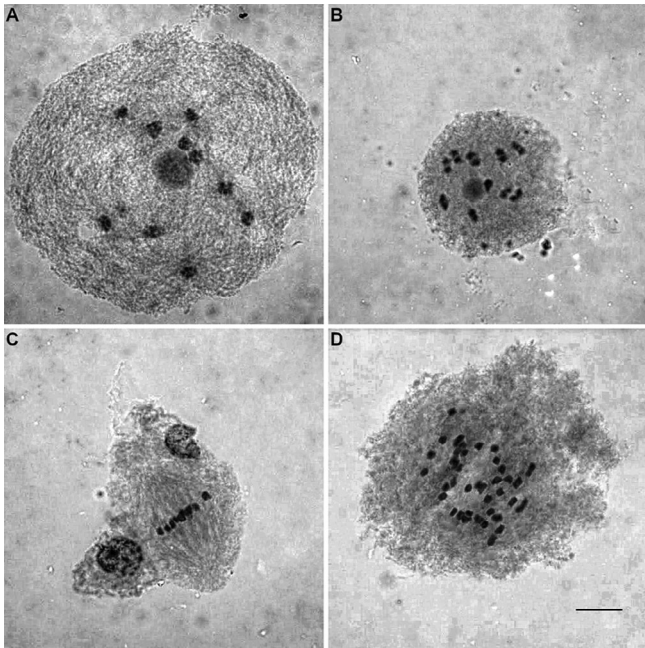


Fig. 27. Meiotic cells of *Paspalum* group Parviflora. **A**, *Paspalum multicaule*, R.C. Oliveira & al. 3014, $2n = 20$ (diakinesis with 10II); **B**, *P. scalare*, C.O. Moura & al. 60, $2n = 20$ (diakinesis with 10II); **C**, *P. clavuliferum*, R.C. Oliveira & al. 3006, $2n = 20$ (metaphase I with 10II); **D**, *P. hyalinum*, C.O. Moura & Y.F. Figueira-Soares 95, $2n = 40$ (anaphase I). — Scale bar = 10 μ m.

Paspalum hyalinum Nees ex Trin.

* $2n = 40$, CHN. Brazil, Mato Grosso, Alto Araguaia, 17°24'08.2"S, 53°13'28.6"W, 21 Feb 2016, C.O. Moura & Y.F. Figueira-Soares 95 (UB) [Fig. 27D].

Paspalum multicaule Poir.

$2n = 20$, CHN. Brazil, Amazonas, Presidente Figueiredo, 02°02'35.1"S, 59°51'16.3"W, 25 Apr 2015, R.C. Oliveira & al. 3012 (UB); Brazil, Amazonas, Presidente Figueiredo, 02°03'22.7"S, 59°55'59.8"W, 25 Apr 2015, R.C. Oliveira & al. 3014 (UB) [Fig. 27A]; Brazil, Goiás, Chapadão do Céu, 18°15'01.0"S, 52°53'10.9"W, 23 Feb 2016, C.O. Moura & Y.F. Figueira-Soares 106 (UB); Brazil, Mato Grosso, Chapada dos Guimarães, 15°26'07.7"S, 55°51'23.4"W, 19 Feb 2016, C.O. Moura & Y.F. Figueira-Soares 91 (UB); Brazil, Pará, Vigia, 00°29'33"S, 48°03'15"W, 19 Jul 2016, P.L. Viana & R.C. Oliveira 6251 (MG).

Paspalum scalare Trin.

$2n = 20$, CHN. Brazil, Goiás, Alto Paraíso de Goiás, 14°11'11.1"S, 47°36'15.5"W, 29 Jul 2015, C.O. Moura & al. 60 (UB) [Fig. 27B], C.O. Moura & al. 63 (UB).

Meiotic chromosome numbers were determined from pollen mother cells, following Sousa & al. (2017). Young inflorescences were collected in the field, from natural populations. They were fixed in ethanol glacial : acetic acid (3 : 1) for 24 h, at environmental temperature, and stored in a refrigerator in 70% ethanol until analysis. Microsporocyte slides were prepared by maceration of anthers and stained with 2% acetocarmine.

Paspalum L. is a Neotropical genus with few species in the Old World. Bonasora & al. (2018) mentioned c. 350 species in *Paspalum*,

of which over 200 inhabit ecologically diverse areas throughout Brazil (Oliveira & Valls, 2015).

Cytological studies show that many species of *Paspalum* consist of both sexual, self-incompatible diploid cytotypes, and apomictic, pseudogamous, and self-fertile polyploids (Quarín & Norrmann, 1990; Quarín, 1992; Valls, 2000).

The species analyzed in the present work are members of the informal group Parviflora (Chase, 1929), treated as section by Rodríguez (1999). *Paspalum* group Parviflora is not monophyletic and associates in a clade (Scataglini & al., 2014) with species filed in the informal groups Notata and Plicatula. The circumscription of many species of this clade is the most problematic in *Paspalum*, and knowledge on the chromosome number and its relationship to apomixis and sexuality is important for understanding the taxonomic complexity and species delimitation.

Chromosome counts for the four species confirmed the basic number of $x = 10$, a characteristic of most species of the genus (Zuloaga & al., 2004; Hojsgaard & al., 2009).

Previous records of $2n = 20$ chromosomes for *P. clavuliferum* (Reeder, 1967; Pohl & Davidse, 1971; Morrone & al., 2006), *P. multicaule* (Davidse & Pohl, 1972, 1974, 1978; Sede & al., 2010), and *P. scalare* (Pozzobon & al., 2008) were confirmed. Distinct ploidy levels within species from the Parviflora group have already been found in *P. clavuliferum*, with $2n = 40$ chromosomes (Peñaloza & al., 2008).

A cytotype of *P. hyalinum* with $2n = 40$ chromosomes was identified for the first time; the count previously cited for this species is $2n = 20$ (Rodrigues & al., 2001). *Paspalum multicaule* is considered exclusively diploid ($2n = 2x = 20$) (Scataglini & al., 2014), and we confirmed this information in five natural populations from four Brazilian states.

An unusual predominance of diploidy is observed in species of the Parviflora group of *Paspalum*. This finding is extremely important for this genus, where polyploidy is present in almost 80% of the species (Scataglini & al., 2014), with predominance of the tetraploid level (Quarín, 1992). The results obtained in this research, as in other studies, once again confirm the cytological diversity found in *Paspalum* (Pozzobon & al., 2000; Morrone & al., 2006; Peñaloza & al., 2008; Pozzobon & al., 2008).

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