KARYOLOGICAL NOTES ON *GENISTA* SECT. *SPARTIOIDES* SPACH WITH EMPHASIS ON WESTERN SPECIES AND *G. PILOSA* L. (*GENISTEAE - FABACEAE*)

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Abstract: A karyological analysis of some taxa of *Genista* sect. *Spartioides*, distributed in the western part of the Mediterranean region, was carried out. In the *Genista cinerea* group, *G. majorica* and *G. cinerea* ssp. *cinerea* have the chromosome number 2n = 48+(0-2B), while a population of *G. cinerascens* from Portugal has the new numbers with higher degrees of ploidy 2n = 72+(0-5B), rarely 2n = 96+(0-2B). *G. florida s.l.*, like ssp. *florida* and ssp. *polygaliphylla*, have 2n = 48+(0-3B), while ssp. *maroccana* 2n = 46+(0-2B). A new number 2n = 72, with a different grade of ploidy, was counted for *G. obtusiramea*. In several populations of *G. pilosa* the euploid number 2n = 24+(0-3B) was found; only in one population from Val D'Aosta the aneuploid numbers 2n = (40, 42), 44+(0-1B) were counted. A comparison was also made with karyological data already available for all the western taxa of sect. *Spartioides* and for *G. pilosa*.

Introduction

Genista subgen. *Genista* (= subgen. *Stenocarpus* Spach *p.m.p.*) includes about forty taxa, which have been arranged by Gibbs (1966) in four sections: sect. *Genista*, sect. *Spartioides* Spach, sect. *Erinacoides* Spach, and sect. *Scorpioides* Spach. The species of subgen. *Genista* differ from those of the other two subgenera (*Phyllobotrys* Spach and *Spartocarpus* Spach) mainly in some characters of the corolla (broadly ovate standard, as long as the wings and keel); other differential, although less constant, characters concern the leaves, the branching pattern, the spines and the legume (Gibbs 1966).

Sect. *Spartioides* (= sect. *Chamaesparton* Griseb. *apud* Talavera 1999) is the largest of the subgenus. It includes non-spiny shrubs with alternate branching, simple leaves with pulvinules that may be prominent, and three vascular traces (Pellegrin 1908), broadly ovate standard, usually with sericeous hairs, pubescent keel, a narrowly oblong and several-seeded legume, with sericeous to lanate hairs (Gibbs 1966). The same Author includes in sect. *Spartioides* the sect. *Chamaespartum* Spach with the only species *Genista pilosa* L.

The species of this section occur mostly in the Mediterranean region. Two main distribution centres may be singled out: a Western (S Spain and NW Africa), and an Eastern one (Balkan Peninsula and Anatolia); only *Genista pilosa* is widely distributed in W and C Europe, extending to S Sweden, C Italy and Macedonia (Gibbs 1966).

This paper presents a karyological study on the western Mediterranean taxa of the section.

The western species are: *Genista ramosissima* (Desf.) Poir. in Lam., *G. ausetana* (O. Bolòs & Vigo) Talavera, *G. majorica* Cantó & M. J. Sánchez, *G. cinerea* (Vill.) DC. in Lam. & DC., *G. cinerascens* Lange, *G. jimenezii* Pau, *G. valentina* (Willd. ex Spreng.) Steud., *G. florida* L., *G. pseudopilosa* Coss., *G. teretifolia* Willk., *G. obtusiramea* J. Gay ex Spach (Talavera 1999).

Genista florida is found in the Iberian Peninsula, in SE France and in Morocco; ssp. *florida* (C and S Spain, Morocco/Moyen Atlas and dubitatively Portugal) and ssp. *polygaliphylla* (Brot.) Coutinho [= ssp. *leptoclada* (Spach) Coutinho] (N Spain, N Portugal and SE France) were described for Europe; *G. florida* ssp. *maroccana* (Ball) Cantó *et al.* (= *G. florida* var. *maroccana* Ball) is endemic to Haut Atlas in Morocco (Raynaud 1979, Maire 1987, Cantó *et al.* 1997).

Genista ramosissima, the type species of the section, is found in SE Spain and in the northern regions of Algeria and Morocco; *G. pseudopilosa* grows in the southeastern provinces of Spain, in Morocco and Algeria; *G. teretifolia* is endemic to a small area of N Iberian Peninsula; *G. obtusiramea* is endemic to the north-eastern part of the Iberian Peninsula (Maire 1987, Cantó *et al.* 1997, Talavera 1999).

The other species constitute the fairly homogeneous group of *Genista cinerea*. Only *G. cinerea* was known to Spach (1845), while Gibbs (1966) mentions also *G. valentina*. Cantó & Sánchez (1988), followed by Greuter *et al.* (1989) and Cantó *et al.* (1997), include three species in this group: *G. cinerascens*, spread in the central and western parts of the Iberian Peninsula, *G. majorica*, endemic to Mallorca, and *G. cinerea*. The last species mentioned is divided in a number of endemic vicariant subspecies: ssp. *ausetana* O. Bolòs & Vigo (NE Spain and S France), ssp. *valentina* (Willd. ex Spreng.) Rivas-Martínez (E Spain), both elevated to species rank by Talavera (1999), ssp. *murcica* (Cosson) Cantó & M. J. Sánchez (SE Spain), ssp. *speciosa* Rivas Goday & T. Losa ex Rivas-Martinéz *et al.* (S Spain and NW Africa) and ssp. *cinerea* (SE France and the neighbouring area in Italy).

Genista jimenezii, recently revalued by Talavera (1999), is endemic to a small area in SE Spain.

Genista pulchella Vis. (= *G. villarsii* G.C. Clementi), a species with a disjunct distribution in S France and the eastern Adriatic coast (Croatia, Bosnia and Hercegovina, Montenegro and Albania) (Hayek 1924/27, Gibbs 1966, Greuter *et al.* 1989), once included by Gibbs (1966) in sect. *Spartioides*, is placed by Uribe-Echebarría & Urrutia (1988) in sect. *Erinacoides* Spach, together with the allied taxon *G. eliassennenii* Uribe-Echebarría & Urrutia, endemic to N Spain (Uribe-Echebarría & Urrutia 1988, 1994).

The taxa of the *Genista cinerea* group are mostly retamoid-like, rarely ephedroid-like, erect shrubs, 0.4 to 1.5 m tall (rarely smaller, such as *G. ausetana* and *G. jimenezii*), with numerous, flexuous branches growing from the base. Both *G. ramosissima* and *G. florida* have a similar *habitus*, *G. obtusiramea* is an ephedroid-like suffrutex, compactly branched, with branches with short internodes, not very leafy. All these taxa are nanophanerophytes and/or microphanerophytes (Gibbs 1966, Cantó & Sánchez 1988, Cantó *et al.* 1997, Talavera 1999).

Genista teretifolia and *G. pseudopilosa* are smaller subshrubs (0.1 to 0.35 m tall), much branched at the base, the former tending to form hummocks, the latter sprawling or decumbent, with ascending and mostly semi-herbaceous stems; *G. pilosa* is a much branched, prostrate shrub, rooting from the nodes, sometimes erect, up to 0.4 m tall. These species are chamaephytes (Gibbs 1966, Cantó & Sánchez 1988, Cantó *et al.* 1997, Talavera 1999).

Cantó *et al.* (1997) suggested, on the base of phytochemical (alkaloids and isoflavonoids), morphological, biogeographical and karyological characters, to divide sect. *Spartioides* in two subsections: subsect. *Chamaespartum* (Spach) Cantó *et al.*, with *Genista pilosa, G. teretifolia* and *G. pseudopilosa,* and subsect. *Spartioides*, with all the other taxa.

New karyological data on some western taxa of the section, as well as previous references for all the species of the area, are given in this paper.

Materials and methods

Karyological investigations were carried out on seeds collected in the field. The localities of the collection are given in Tab. 1. Voucher specimens of the seeds collected by the Authors are deposited in the Herbarium of the Department of Biology, University of Trieste (TSB).

Genista florida ssp. *florida* – Sierra de Gredos, Avila (Hs), 1100 m, 17 Aug 1983, *L. Feoli Chiapella* (TSB).

Genista florida ssp. *maroccana* – Haut Atlas, Route du Tizi-n-Tichka, between Ouarzazate and Marrakech (Ma), 1600 m, 1 Jul 1987, *L. Feoli Chiapella* (TSB).

Genista florida ssp. *polygaliphylla* - Santa Inés, Rio Quesos, Soria (Hs), 1300 m, 2 Jul 1967, *A. Segura Zubizarreta* (TSB).

Genista majorica – Es Mal Pas, Alcudia, Mallorca (Bl), 100 m, 4 Aug 1999, *L. Feoli Chiapella et E. Feoli* (TSB); Embassament des Gorg Blau, Lluc, Mallorca (Bl), 650 m, 6 Aug 1999, *L. Feoli Chiapella* (TSB).

Mitoses were observed on root tips of seedlings, pretreated with 8-hydroxiquinoline, fixed in a 1 : 3 solution of glacial acetic acid: absolute ethanol (Carnoy's fluid), hydrolized in 1 N HCl at 60° C for six minutes and stained using the routine Feulgen method. Slides were prepared with the squash technique. For each population about 10 metaphase plates were examined. Only numbers of chromosomes can be given here, because of the size of the chromosomes, too small (0.60 - 2.30 µm) for effective karyotyping. Bigger chromosomes (up to 3.20 µm) were found only in *Genista obtusiramea*.

The nomenclature of sections follows Gibbs (1966), that of species Greuter *et al.* (1989) and Talavera (1999), the latter for the Iberian ones.

Results and discussion

Chromosome numbers of the western taxa of *Genista* sect. *Spartioides*, including those of *G. pilosa*, both obtained by us and resulting from references, are presented in Tab. 1.

The *Genista cinerea* group is karyologically quite homogeneous, especially the subspecies of *G. cinerea:*

ssp. *cinerea* (populations of SE France and NW Italy), ssp. *speciosa* (S Spain) and ssp. *murcica* (SE Spain) were found to have n = 24 and/or 2n = 48. The same chromosome numbers were counted for *G. valentina** (E Spain) and *G. majorica* (Mallorca); Talavera (1999) reports n = 24 and 2n = 48 for *G. jimenezii* as well, although this author does not give any information about references and sampling site. Our data on *G. majorica* and *G. cinerea* ssp. *cinerea* (Fig. 1) confirm previously obtained chromosome numbers.

The cromosome number 2n = 48, by far the most common in *Genista*, *Cytisus* Desf. and in the *Genisteae* in general, is traced back to the secondary basic number x = 12 by e.g. Gilot (1965), Sañudo (1979) and Goldblatt (1981).Verlaque (1988) considers x = 6 as the basic number in *Genista.*

Since an adequate morphological analysis is frequently difficult to obtain, the definition of the basic number in *Genisteae* is mostly founded only on the study of the chromosome numbers effectively observed in the various species. At this stage of the research we think that the hypothesis of Verlaque (1988) has not been proved enough, since no diploid species with 2n = 12 has been yet found. We also consider x = 12 as the most likely secondary basic number.

Genista cinerascens has the same basic number (x = 12) of the other taxa of the *G. cinerea* group, although it has a different level of ploidy. Chromosome numbers such as n = 12 and/or 2n = 24 have been found in many populations of C Spain (Sañudo 1972, Gallego Martín *et al.* 1984, 1985, Cubas *et al.* 1998). *G. cinerascens* is the only diploid species in the group; this taxon, regarded by Gibbs (1966) as a variety of *G. cinerea*, is on the contrary considered as an independent species by Cantó & Sánchez (1988) and Cantó *et al.* (1997), on the basis of the karyological difference and of morphology (pulvinules, standard completely covered by hairs), phytochemistry and ecology (the species grows on siliceous soil, other taxa of the group on limestone). The data presented here (Fig. 1), based on samples from the Serra da Estrela (Portugal), with 2n = 72 and, less frequently, 2n = 96, show higher degrees of ploidy.

Genista ausetana is the only species of the group which was not yet karyologically investigated.

Thus, the *Genista cinerea* group, homogeneous in morphology and karyology, has its center of differentiation in the Iberian Peninsula. Sañudo (1972) and Cardona (1976) consider *G. cinerascens* (diploid) to be the common ancestor of all the other taxa of the group (all tetraploid). According to Rivas-Martínez (1974), followed by Cantó & Sánchez (1988), *G. cinerascens* is the patroendemic taxon (after Favarger & Contandriopoulos 1961). The other vicariant tetraploid taxa of the group (apoendemic) have probably evolved from this species, spreading North and South, as well as East, while in the West a population (Serra da Estrela, Portugal) with higher degrees of ploidy (mostly hexaploid, rarely octoploid) has differentiated. This condition could be interpreted as a case of cryptoendemism (after Contandriopoulos 1982). Further investigations will give information on the degree of ploidy of other populations in the W Iberian Peninsula and could eventually confirm this trend. According to Verlaque (1988), the evolution of the group results from the combination of polyploidy and adaptive radiation, reinforced by geographic isolation.

Genista ramosissima, morphologically similar to *G. cinerea* and regarded by Maire (1987) as a subspecies of the latter, has the same chromosome number n = 24 and 2n = 48.

Karyological data are available for *Genista florida s.l.*, as well as for ssp. *florida* and ssp. *polygaliphylla.* Cubas *et al.* (1998) point out that these taxa are sometimes difficult to identify; moreover, their distribution areas are not clearly separated (Cantó *et al.* 1997). The tetraploid chromosome number n = 24 and 2n = 48 has been found in populations of *G. florida s.l.* and of ssp. *polygaliphylla*, both of N and C Spain, N Portugal. Recently, Cubas *et al.* (1998) reported n = 23 and 2n = 46 for various populations of both ssp. *florida* (C and S Spain, Portugal) and ssp. *polygaliphylla* (C and N Spain). Completely different chromosome numbers (n = 15 and 2n = 30) are reported by Gallego Martín *et al.* (1984, 1985) for populations from provinces of Zamora and Salamanca (Spain), "due to mis-counts" according to Cubas *et al.* (1998).

Our data (Fig. 2), concerning a population of ssp. *florida* (Sierra de Gredos), one of ssp. *polygaliphylla* (Santa Inés), and two from a region where ssp. *polygaliphylla* prevails (not excluding ssp. *florida*), show always eutetraploid chromosome numbers. No previous karyological data are known for *G. florida* ssp. *maroccana*, endemic to Morocco; we counted 2n = 46+(0-2B). *Genista florida* seems thus to have both eupolyploid and hypoaneuploid populations.

Karyological data on *Genista obtusiramea* are extremely scarce: the only author who gives information about the species is Sañudo (1972), who reports the tetraploid chromosome number 2n = 48, while our data point to the hexaploid number 2n = 72 (Fig. 2).

Genista teretifolia has an eupolyploid chromosome

* The population of Sierra Espuña (Murcia), reported by Sañudo (1972) as *Genista valentina*, corresponds to *G. cinerea* ssp. *murcica* (Cantó *et al.* 1997, Cubas *et al.* 1998).

Tab. 1 - Chromosome numbers of the species of *Genista* sect. *Spartioides* with bibliographic references and source of the studied populations. The abbreviations of the territories follow Flora Europaea and Greuter *et al.* (1989) for African states.

TAXON	APLOID No.	DIPLOID No.	REFERENCES	LOCALITY
G. cinerea ssp. cinerea		***48***	***present paper***	***Toudon, Alpes - Maritimes (Ga) - Bot Gard, Nice***
		48	,,	***Provence (Ga) - Bot. Gard., Liège***
		48 + (0 - 2B)	,,	***Rocca Barbona, Imperia (It) - Bot Gard., Genova***
	24		Forissier (1973 a, sub G. cinerea)	Limone, Liguria (It)
	24	48	Afzal - Rafii ef al. (1986)	Montagne de Lure (Ga)
		48	Verlaque (1988)	Provence (Ga)
G. cinerea ssp. murcica	24		Cubas *et al.* (1998)	Campoamor, Alicante (Hs)
	24		,,	Promontorio del Cabo de Gata, Almería (Hs)
	24		Sañudo (1972, sub G. valentina, *fide* Cantó *et al.* 1997, Cubas *et al.* 1998)	Sierra Espuña, Murcia (Hs)
G. cinerea sp. speciosa	24		Sañudo (1972)	Alhama, Granada (Ha)
	24		,,	Sierra Elvira, Granada (Ha)
	24		Cubas *et al.* (1998)	Fuente Segura - Santiago de la Espada, Jaén (Hs)
G. cinerascens		***72 + (0 - 5B)*** ***96+(O-2B)***	present paper	***Serra da Estrela (Lu) - Bot. Gard., Coimbra***
	12		Cubas *et al.* (1998)	Puerto del Pico, Avila (Hs)
	12		,,	Ramacastañas - Mombeltrán, Avila (Hs)
	12		,,	Arrabal de Pesquera, Avila (Hs)
	12		,,	Sierra de San Vicente, Toledo (Hs)
	12	24	Sañudo (1972, sub G. cinerea f. cinerascens)	Béjar, Salamanca (Hs)
	12	24	,,	Guadalix, Madrid (Hs)
	12	24	Gallego Martin *et al.* (1984, 1985, sub G. cinerea ssp. cinerascens)	La Honfría, Salamanca (Hs)
G.jimenezii	24	48	Talavera (1999)	
G. majorica		***48***	***present paper***	***Es Mal Pas, Alcudia, Mallorca (Bl)***
		48	,,	***Embassament des Gord Blau, Lluc, Mallorca (Bl)***
	24		Cardona (1976, sub G. cinerea ssp. leptoclada)	Caimari, Mallorca (Bl)
G. valentina	24		Sañudo (1972)	Enguera, Valencia (Hs)
G. florida		***48***	***present paper***	***Serra da Estrela (Lu) - Bot. Gard., Coimbra***
		48 + (0 - 2B)	,,	***Portugal - Bot. Gard., Lisboa***
	24		Sañudo (1972)	Robregordo, Madrid (Hs)
	24		,,	Sotillo del Rincón, Soria (Hs)
		48	Fernandes *et al.* (1977)	Vila Real, Murça (Lu)
		48	,,	Fernandes Covilhã, Penhas de Saúde ***(Lu)***
		48	Santos (1944/45)	Bot. Gard., Leiden
G. florida ssp. florida		***48 + (0 - 3B)***	***present paper***	***Sierra de Gredos, Avila (Hs)***
	23		Cubas *et al.* (1998)	Casillas, Avila (Ha)
	23		,,	Puerto de la Ragua - Laroles, Granada (Hs)
	23		,,	Cabeza Líjar - Cerro Piñonero, Madrid (Hs)
	23		,,	Serra da Estrela, Penhas de Saúde, Beira Alta (Lu)
		46	,,	Arenas de San Pedro, Poyalea del Hoyo, Avila (Hs)
	15 (?)	30(?)	Gallego Martin *et al.* (1984, 1985)	Cilleros de la Bastida, Salamanca (Hs)
	15(?)	30(?)	,,	Candelario, Salamanca (Hs)
G. florida ssp. maroccana		***46 + (0 - 2B)***	***present paper***	***Haut Atlas, Route da Tizi - n - Tichka (Ma)***

Tab. 1 - Continued.

G. florida		***48***	***present paper***	***Santa Inés, Soria (Hs) - lg. A. Segura Zubizarreta***
ssp. polygaliphylla	23		Cubas *et al.* (1998)	Sierra de Peña de Francia, Salamanca (Hs)
	23		„	Sierra de Urbión, Soria (Hs)
	24		Sañudo (1972, subsp. leptoclada)	Brañosera, Palencia (Hs)
		46	Cubas *et al.* (1998)	Puerto de Piqueras - Logroño, la Rioja (Hs)
		46	„	Lago de Sanabria, Zamora (Hs)
	15 (?)	30 (?)	Gallego Martin *et al.* (1984, 1985)	Mombuey, Zamora (Hs)
G. ramosissima	24		Sañudo (1972)	Sorbas, Almería (Hs)
		48	Cubas *et al.* (1998)	Turre - Alfaix, Almería (Hs)
G. obtusiramea		***72***	***present paper***	***Picos de Europa, Puerto del Ponton, Oviedo (Hs) -Bot Gard., Berlin***
		48	Sañudo (1972)	p.to S. Glorio, León (Hs)
G. teretifolia	24	48	Sañudo (1972)	Olague, Navarra (Hs)
G. pseudopilosa	36	72	Sañudo (1972)	Sierra Segura,
G. pilosa		***24***	***present paper***	***Il Broccio, Siena (It) - Bot. Gard., Siena***
		24	„	***Sassello, Savona (It) - Bot. Gard., Genova***
		24	„	***Granile, Alpes – Maritimes (Ga) - Bot. Gard., Genova***
		24	„	***Côte – d'Or (Ga) – Bot. Gard., Liège***
		24 + (0 - 1B)	„	***Ochtendung Nettetal (Ge) - Bot. Gard., Münster***
		24 + (0 - 2B)	„	***Eifel, Nordrhein Westfalen (Ge) – Bot. Gard., Bonn***
		24 + (0 - 2B)	„	***Puy–de- Dôme (Ga) – Bot. Gard., Lausanne***
		24 + (0 - 2B)	„	***Ponte della Pia, Siena (It) - Bot. Gard., Siena***
		24 + (0 - 2B)	„	***Molina di Quosa, Pisa (It) - Bot. Gard., Pisa***
		24 + (0 - 2B)	„	***Haute - Savoie (Ga) - Bot. Gard., Genève***
		24 + (0 - 3B)	„	***Piazza di Deiva, La Spezia (It) – Bot. Gard., Genova***
		24 + (0 - 3B)	„	***Aude (Ga) - Bot. Gard., Liège***
		(40, 42)	„	***V. Ayas, Challand St. Anselme, Aosta (It) - Bot.***
		44 + (0 - 1B)		***Gard. Paradisia, Cogne***
	11		Forissier (1973 a)	La Celle, Corrèze (Ga)
	11		„	Grand Veymont (Ga)
	11		„	La Sèche des Amburnex (He)
	11		„	Südlicher Wienerwald (Au)
	10, 11, 12	22, (24)	Verlaque *et al.* (1987)	Forêt du Dom, Var (Ga)
		20, 21, 22 + B	„	Notre - Dame - du - Figuier, Var (Ga)
		20, 22	„	Collobrières, La Verne, Var (Ga)
		(21), 22	„	Forcalquier, Alpes - de - Haute - Provence (Ga)
		21, 22	„	Col de la Fourche, Var (Ga)
		22	„	Saint - Chély - d'Apcher, Lozère (Ga)
		22	Sañudo *et al.* (after Sañudo 1979)	Alava (Hs)
		22	Verlaque *et al.* (1987)	entre Signes et Méounes, Var (Ga)
		22, (23)	„	crête orientale du Luberon, Vaucluse (Ga)
		22, (23, 24)	„	Mont Ventoux, Vaucluse (Ga)
		22, (23, 24)	„	Montagne de Lure, Alpes - de - Haute - Provence (Ga)
		22, (24)	„	Grand - Luberon, Mourre - Nègre, Vaucluse (Ga)
		22, (24)	„	Bagnols, Var (Ga)
		(22), 24	„	le Forest Saint - Julien, Hautes - Alpes (Ga)
	12	24	Sañudo (1972)	Peñalabra, Santander (Hs)
	12	24	„	Monte Toloño, Alava (Hs)
		24	Verlaque *et al.* (1987)	Mont Mézenc, Haute - Loire (Ga)
		24	„	Margeride, Haute - Loire (Ga)
		24	Löve & Kjellqvist (1974)	Sierra de Albarracín, Sierra Alta, Teruel (Hs)
		24	Leute (1974)	Ulrichsberg, Klagenfurt, Carinthia (Au)
		24	Krusheva (1975)	Vitosha, Kladniza (Bu)
		24	Natarajan (1978)	Bel-Air, Montpellier (Ga)
		24	Baksay (after Löve & Löve 1961)	
		24	Tschechov (1931)	Bot. Gard., Glasnevin, Dublin
		24	Gilot (1965)	Bot. Gard., Liège
	22		Forissier (1973 b)	Prades, Pyrénées orientales (Ga)
	22	43, 44, 45	Verlaque *et al.* (1987)	Lure, Joncas, Alpes - de - Haute - Provence (Ga)
	22	44	„	Pic de Neulos, Pyrénées - Orientales (Ga)
		44	„	Col de Perthus, Pyrénées - Orientales (Ga)

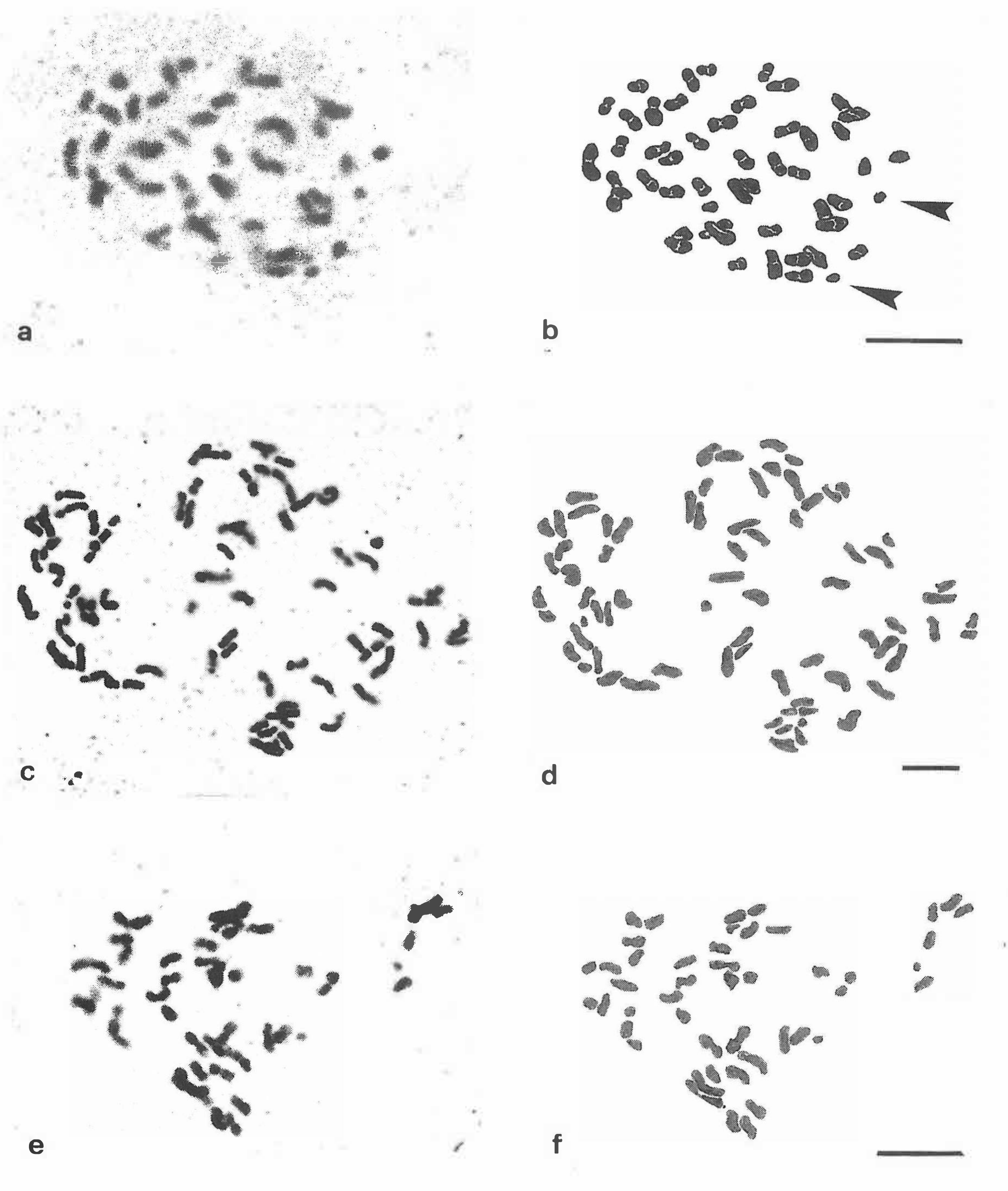

Fig. 1 - Photomicrographs (a, c, e) and drawings (b, d, f) of somatic metaphase plates of *Genista cinerea* ssp. *cinerea* (a, b), 2n = 48+2B, *G. cinerascens* (c, d), 2n = 72, and *G. majorica* (e, f), 2n = 48. Arrows indicate B-chromosomes. Scale bar = 5 µm.

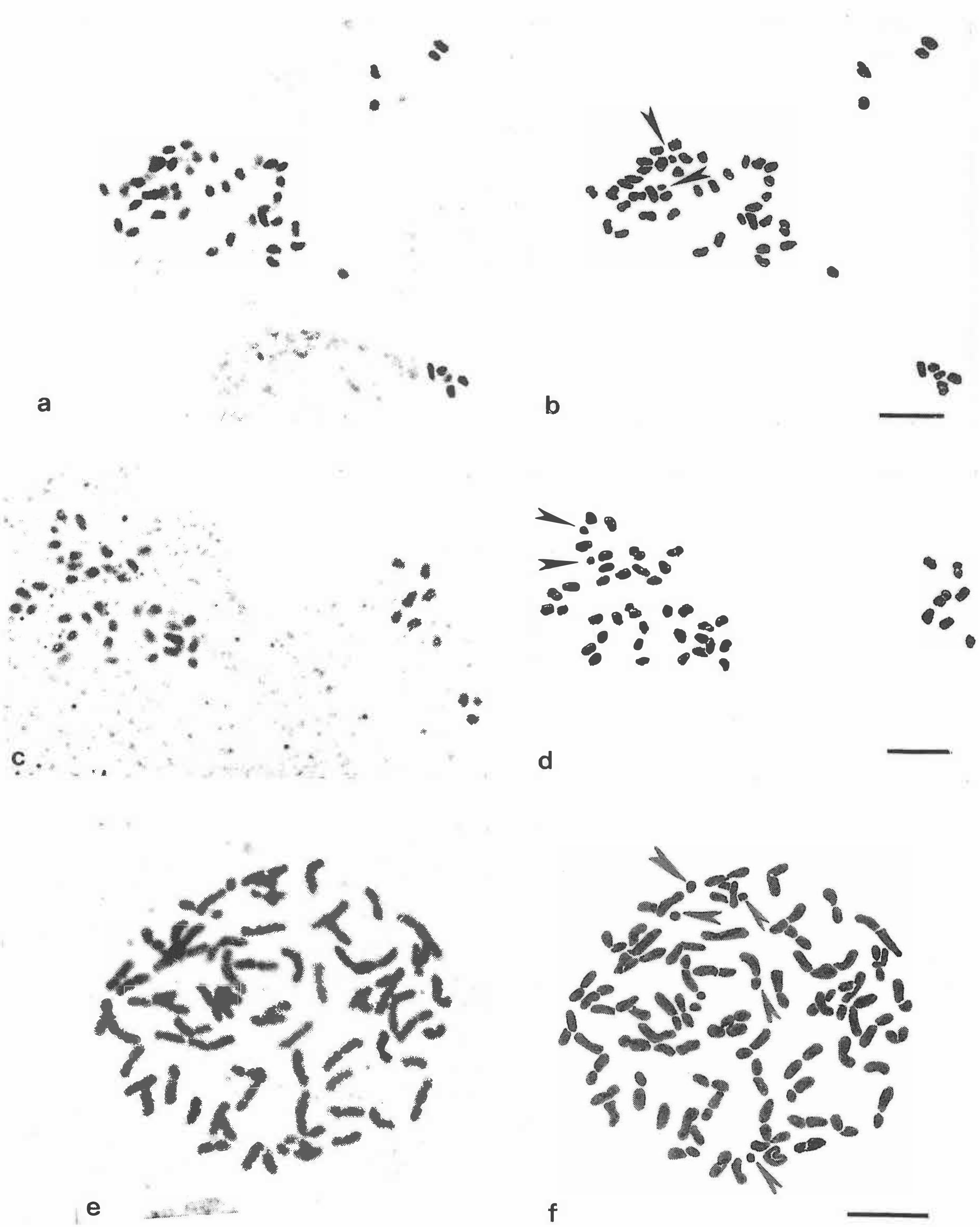

Fig. 2 - Photomicrographs (a, c, e) and drawings (b, d, f) of somatic metaphase plates of *Genista florida* (a, b), 2n = 48+2B, *G. florida* ssp. *maroccana* (c, d), 2n = 46+2B, and *G. obtusiramea* (e, f), 2n = 72+5B. Arrows indicate B-chromosomes. Scale bar = 5 μm.

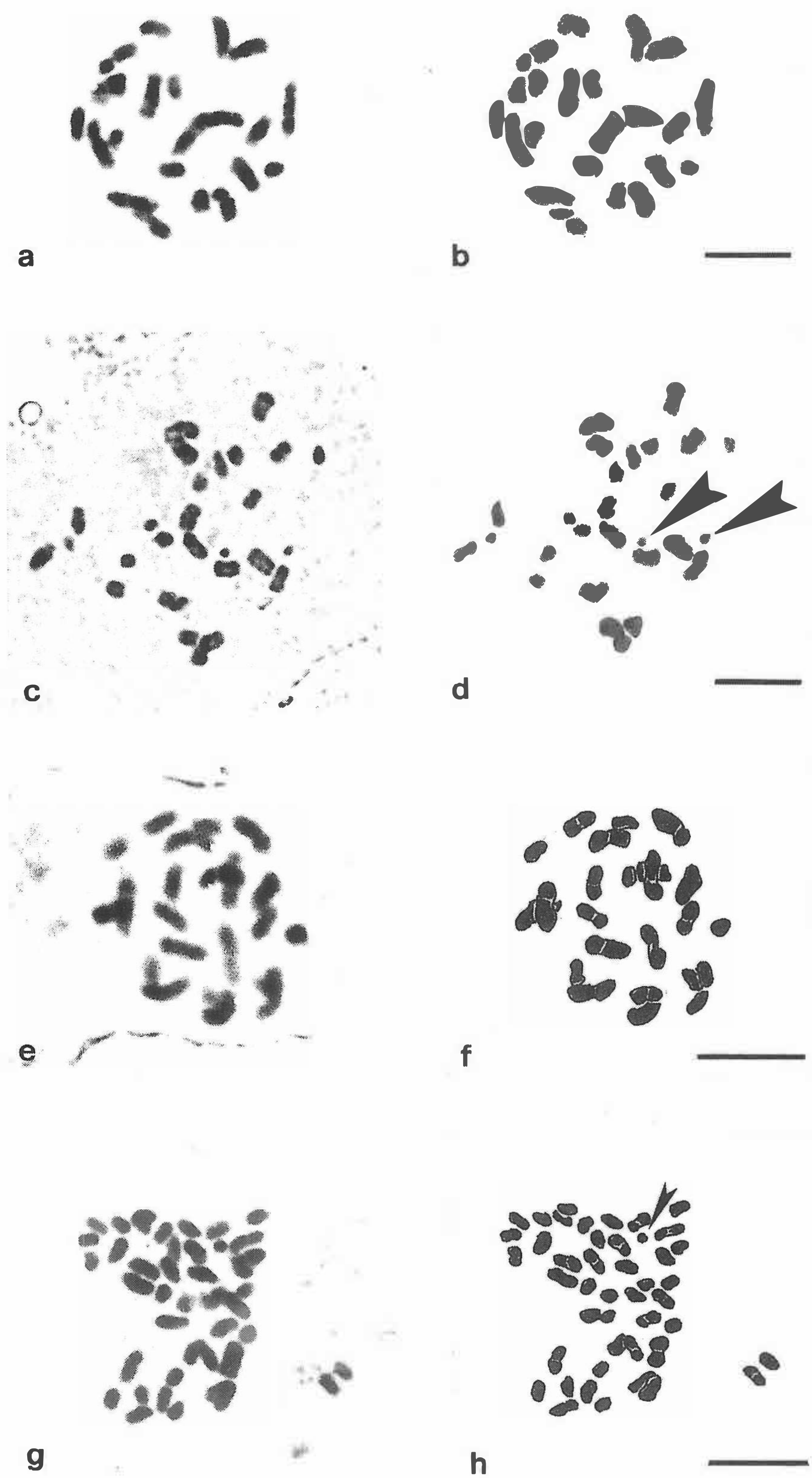

Fig. 3 - Photomicrographs (a, c, e, g) and drawings (b, d, f, h) of somatic metaphase plates of *Genista pilosa* from Ochtendung Nettetal (a, b), 2n = 24, Haute-Savoie (c, d), 2n = 24+2B, Granile, Alpes-Maritimes (e, f), 2n = 24, and V. Ayas, Challand St. Anselme (g, h), 2n = 44+1B. Arrows indicate B-chromosomes. Scale bar = 5 μm.

complement with 2n = 48 as well. The only karyological report available for *G. pseudopilosa* (Sañudo 1972) is 2n = 72; further research will be necessary to formulate a valid hypothesis on the basic number of this species.

Genista pilosa, the species of the section with the broadest distribution, is mostly diploid, with n = 12 and 2n = 24 (in material coming from Austria, Bulgaria, France and Spain). In various French populations, in one from Switzerland, in one from Spain and in an Austrian one, Forissier (1973a), Sañudo *et al.* (after Sañudo 1979) and Verlaque *et al.* (1987) have found hypoaneuploids with n = (10), 11 and 2n = (20, 21), 22, (23). To conclude, Forissier (1973b) and Verlaque *et al.* (1987) have also found aneuploid chromosome numbers, but with a higher level of ploidy, such as n = 22 and/or 2n = (43), 44, (45) in some populations of the E Pyrenees and in one of the Haute-Provence. Verlaque (1988) claims that while only euploids with 2n = 24 are present in the northern, southwestern and southeastern parts of the distributional area, in the central and southern part more or less stabilized aneuploids with 2n = 22 prevail and sometimes are exclusive; from these, polyploid races with 2n = 44 are supposed to have originated.

Our data (Fig. 3) point out mostly euploid numbers 2n = 24+(0-3B) in several populations from NW and C Italy, C and S France and CW Germany. Exclusively aneuploid numbers 2n = (40, 42), 44+(0-1B) were found only in a population of Val D'Aosta (Italy).

Sañudo (1972) regards *Genista pilosa*, *G. teretifolia* and *G. pseudopilosa* as close systematic relatives; in the author's views, *G. pilosa* (diploid) is the common ancestor from which, through chromosomal duplications, the other two species (polyploid) have evolved.

Among the eastern species of the section, the taxa of the *Genista sericea* group are the only ones which were karyologically studied. *G. sericea* Wulfen is an Illyrian amphiadriatic species with 2n = 48, in both var. *sericea* and var. *rigida* Pamp., and basic number x = 12. *G. subcapitata* Pancic, found in the C Balkans, the Greek endemic taxa *G. halacsyi* Heldr., *G. sakellariadis* Boiss. & Orph. and *G. millii* Boiss. have respectively 2n = 18, 2n = 18+2B and the last two 2n = 36+2B, with x = 9 (Cusma Velari *et al.* 1996).

The secondary basic number x = 12 seems to be the most common in the western taxa of the sect. *Spartioides*, with mostly euploid species; in both subsections there are a diploid species (*Genista cinerascens* in subsect. *Spartioides, G. pilosa* in subsect. *Chamaespartum*), tetraploid species, and at least a taxon with one or more higher grades of ploidy (hexaploid, rarely octoploid, cytotypes in *G. cinerascens* and *G. obtusiramea* in the first subsection, *G. pseudopilosa* in the second).

A tendency towards descending aneuploidy was found in both subsections (respectively in *Genista florida* and in *G. pilosa*); this tendency is not very common in *Genista*, but rather in *Teline* Medik. (Sañudo 1973, Cusma Velari *et al.* 2000) and in *Cytisus* (Cusma Velari & Feoli Chiapella 1994).

The secondary basic number x = 9 is found in the eastern taxa of the section; it may be interpreted as derived from x = 12 by descending aneuploidy. The number x = 9 has proved to be more common in *Genista* than previously assumed: it is also present in sect. *Erinacoides*, where it is the most common basic number (Sañudo 1971, Talavera 1999), and in sect. *Voglera* (Gaertn., Mey. & Schreb.) Spach (as in *G. hispanica* L., *G. tridens* (Cav.) DC., Sañudo 1972).

The heterogeneity of *Genista*, due to polyploidy, disploidy and aneuploidy is well-known (Sañudo 1979, Verlaque 1988). Chromosome numbers which can be traced back to the secondary basic numbers x = 11 and x = 10 were also reported in some species of *Genista*; they presumibly derive from x = 12 by descending aneuploidy, as well. The number x = 11 was found in some taxa of sect. *Voglera* (*G. sylvestris* group, Cusma Velari & Feoli Chiapella 1991) and of sect. *Spartocarpus* Spach (*G. sessilifolia* DC., Krusheva 1975), whereas x = 10 is present in some species of sect. *Scorpioides (G. scorpius* (L.) DC., *G. carpetana* Lange, Sañudo 1971) and of sect. *Spartocarpus (G. spartioides* Spach, *G. haenseleri* Boiss., Sañudo 1971).

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