

CYTOLOGICAL STUDIES IN SOME FLOWERING PLANTS FROM SOUTHERN FRANCE

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SUMMARY

The chromosome number of 55 plant species collected in Southern France was determined.

1. INTRODUCTION

During the summer of 1966 the first author collected a number of seeds of various species of mediterranean plants. The plants raised from these seeds were grown in the botanical garden of the Utrecht University. Since many plant species show intraspecific cytological variation, the authors decided to investigate the collected material from the cytological point of view. In spite of extensive research in the European flora, still a considerable number of species remain cytologically untouched, whereas many others were studied only once, so that the intraspecific variation, if any, could not be detected. These studies are intended to fill some gaps in our knowledge of cytogeography. A comparison of the results obtained by other authors is given under the heading: "Notes on some species".

2. MATERIAL AND METHODS

Most plants were collected in the French departments Hérault and Aveyron. A few other plants had been transferred by Dr. J. Braun-Blanquet from their natural habitat to the SIGMA-park. In a number of species some phytosociological notes have been added.

Roottips of the seedlings were fixed in Karpechenko's fixative, embedded in paraffin-wax, sectioned at 15 micron, and stained according to Heidenhain's haematoxylin method.

Microscopic preparations as well as the herbarium material are preserved in the Biosystematic Department of the Institute of Systematic Botany, Utrecht.

3. RESULTS

Table 1 lists the species investigated, arranged alphabetically according to the families and within the family according to the genera. Literature references are mentioned only if our results deviate from those of other authors or if the species concerned was counted only once before.

Acanthaceae					
<i>Acanthus mollis</i> L.	6028	Dép. Hérault. Montpellier.		2n = 56	
Campanulaceae					
<i>Campanula erinus</i> L.	6020	Dép. Hérault. Montpellier.		2n = 28	
Caryophyllaceae					
<i>Silene alba</i> (Miller) E. H. L. Krause	5944	Dép. Hérault. Montpellier.		2n = 24	
<i>Silene conica</i> L. ssp. <i>conica</i>	5984	Dép. Hérault. Le Caylar, dry pasture. Alt. 750 m. Dolomite Ref.: Blackburn 1928, Blackburn & Morton 1957, Puech 1963: 2n = 24; Khoshoo & Bhatia 1963: 2n = 20, n = 10.		2n = 20	
<i>Silene saxifraga</i> L.	6026	Dép. Hérault. Pic St. Loup, 25 km. N. of Montpellier. Alt. 690 m. Silicate		2n = 24	
Cistaceae					
<i>Cistus albidus</i> L.	5978	Dép. Hérault. Montpellier, zoo. Alt. 150 m. Garrigues		2n = 18	
<i>Cistus monspeliensis</i> L.	6013	Dép. Hérault. Montpellier, zoo. Alt. 150 m. Garrigues		2n = 18	
<i>Fumana procumbens</i> (Dun.) Gren. & Godron	5949	Dép. Hérault. Carmon-Plage, in the dunes.		2n = 32	
<i>Helianthemum apenninum</i> (L.) Miller	5933	Ref.: Chiarugi 1925: 2n = 32			
Compositae					
<i>Anacyclus clavatus</i> Pers.	5965	Dép. Hérault. Le Caylar, on rocks. Alt. 830 m. Dolomite. Ononidion striatae Br.-Bl. et Suspl.		2n = 20	
<i>Carduncellus mitissimus</i> (L.) DC.	6010	Dép. Hérault. Montpellier. Hordeetum leporini Br. -Bl. Ref.: Martinez-Vasquez 1962: 2n = 18		2n = 18	
<i>Carduus tenuiflorus</i> Curtis	5956	Dép. Aveyron. La Couvertoirade. Alt. 800 m. Dolomite. Astero-Anthyl- lidetum Br.-Bl. Ref.: Delay 1969: n = 12		2n = 24	
<i>Centaurea aspera</i> L.	6027	Dép. Hérault. Montpellier.		2n = 54	
<i>Crepis bursifolia</i> L.	6002	Ref.: Moore & Frankton 1962: 2n = 54			
<i>Erigeron linifolius</i> Willd.	5943	Dép. Hérault. Montpellier. Brachypodietum phoenicoidis Br.-Bl.		2n = 22	
<i>Lapsana communis</i> L.	6012	Dép. Hérault. Montpellier. Ref.: Mehra <i>et al.</i> 1965: n = 27		2n = 8	
<i>Leuzea conifera</i> (L.) DC.	6009	Dép. Hérault. Le Caylar, road side. Alt. 750 m. Ref.: Löve & Löve 1948: 2n = 12; Vaarama in Tischler 1950, Stebbins <i>et al.</i> 1953, Gadella <i>et al.</i> 1966: 2n = 14; Sorsa 1962, 1963; 2n = 16, n = 8		2n = 54	
		Dép. Hérault. St. Jean de Védas, 8 km. W. of Montpellier. Garrigues Ref.: Lorenzo-Andreu & Garcia-Sanz 1950: 2n = 18		2n = 14	

<i>Sonchus oleraceus</i> L.			Dép. Hérault. Montpellier.	2n = 32
<i>Urospermum dalechampsi</i> (L.) Schmidt	6006		Dép. Hérault. Montpellier. Thero-Brachypodietaia Br.-Bl.	2n = 14
	5959		Ref.: Larsen 1956; 2n = 14	
Cruciferae				
<i>Arabis pauciflora</i> (Grimm.) Garcke	5948		Dép. Aveyron. La Couvertoirade. Alt. 840 m. Dolomite. Querceto-Buxetum Br.-Bl.	2n = 14, 14 + 1
<i>Draba aizoides</i> L.	5932		Dép. Hérault. Le Caylar, on rocks. Alt. 780 m. Dolomite. Kemereto-Arenarietum hispidae Br.-Bl.	2n = 16
<i>Diplotaxis erucoides</i> (L.) DC.	5983		Dép. Hérault. Montpellier. Diplotaxidetum erucoidis Br.-Bl.	2n = 14
<i>Malcolmia littorea</i> (L.) R. Br.	6024		Dép. Hérault. Carnon-Plage, in the dunes. Crucianelletum maritimae Br.-Bl.	2n = 20
			Ref.: Manton 1932; 2n = 20	
<i>Sisymbrium officinale</i> (L.) Scop.	5971		Dép. Hérault. Montpellier. Hordeetum leporini Br.-Bl.	2n = 14
Dipsacaceae				
<i>Scabiosa maritima</i> L.	5937		Dép. Hérault. Montpellier. Brachypodietaum phoenicoidis Br.-Bl.	2n = 16
Gentianaceae				
<i>Blackstonia perfoliata</i> (L.) Huds.	6014		Dép. Hérault. Montpellier, zoo. Alt. 150 m. Garrigues	2n = 40
Geraniaceae				
<i>Erodium ciconium</i> (Juss.) L'Hér.	6033		Dép. Hérault. Montpellier. Hordeetum leporini Br.-Bl.	2n = 20
			Ref.: Gauger 1937, Guittonneau 1964, 1965, 1967; 2n = 18; Warburg 1938; 2n = 20	
<i>Geranium columbinum</i> L.	5974		Dép. Hérault. St. Étienne d'Issensac, bank of the river Hérault, along road D.1. Sedeto-Arabidetum vernae Br.-Bl.	2n = 18
<i>Geranium pyrenaicum</i> Burm. f.	5941		Dép. Hérault. Le Caylar, road side. Alt. 750 m.	2n = 28
<i>Geranium rotundifolium</i> L.	5936		Dép. Hérault. Montpellier. Diplotaxidetum erucoidis Br.-Bl.	2n = 26
Globulariaceae				
<i>Globularia aphyllanthos</i> Cr.	6008		Dép. Aveyron. La Couvertoirade. Alt. 830 m. Dolomite. Stipeto-Ononidetum Br.-Bl.	2n = 64
			Ref.: Baksay 1956, Larsen 1957, Löve & Löve 1944, 1957, Schwarz 1964; 2n = 16; Schwarz 1964; n = 8	
Gramineae				
<i>Festuca spadiacea</i> L.	5982		Dép. Hérault. Le Caylar, dry pasture. Alt. 750 m. Dolomite	2n = 42
			Ref.: Levitsky & Kuzmina 1927, Stählin 1929, Radeloff 1930, Litardière 1923, 1949, 1950, Gervais 1965; 2n = 14; Malik & Thomas 1966; 2n = 14,	28

	Labiatae				
	<i>Phlomis lychnitris</i> L.	Dép. Hérault. Montpellier, zoo. Alt. 150 m. Garrigues	2n = 20, 22		
5951		Ref.: Wagner 1948: 2n = 22			
	<i>Salvia verbenaca</i> L.	Dép. Hérault. Montpellier	2n = 64		
6023		Ref.: Yakovleva 1933, Benoist 1937: 2n = 64; Gadella <i>et al.</i> 1966: 2n = 59, 64; Reese 1957: 2n = 42			
	Leguminosae				
	<i>Anagyris foetida</i> L.	Dép. Hérault. Montpellier. Transplanted from North Africa.	2n = 18		
5964	<i>Lathyrus annuus</i> L.	Dép. Hérault. Montpellier. along roads.	2n = 14		
5962	<i>Melilotus neapolitana</i> Tenore	Dép. Hérault. Near d'Arboras, Roches de Deux-Vierges.	2n = 16		
5988	<i>Trifolium campestre</i> Schreb.	Dép. Hérault. Montpellier.	2n = 14		
5969	<i>Trifolium scabrum</i> L.	Dép. Hérault. Montpellier.	2n = 10		
	Liliaceae				
	<i>Dipcadi serotinum</i> (L.) Medik.	Dép. Hérault. Montpellier. Transplanted from the Pyrenees.	2n = 8		
	<i>Nothoscordum fragrans</i> Kunth	Dép. Hérault. Montpellier. Transplanted from the Île de Porquerolles, Dép. Var.	2n = 18		
5970		Ref.: Koerperich 1930: 2n = 16; Messeri 1931, Stenar 1932: 2n = 24; Matsuura & Sutô 1935: 2n = 32; D'Amato 1948, 1949, 1952, Håkansson 1953: 2n = 18; Satô 1942, Satô & Asano 1951, Kurita 1953, Sharma 1956, Tandon & Kapoor 1963, Kurita & Kuroki 1963, Pizzolongo 1963, Khoshoo 1966, Dyer 1967: 2n = 19; Dyer 1967: 2n = 20; Levan & Emsweller 1938, Garber 1944: 2n = 16-22.			
5968					
	Malvaceae				
	<i>Malva sylvestris</i> L.	Dép. Hérault. Montpellier. Hordeetum leporini Br.-Bl.	2n = 42		
5973					
	Papaveraceae				
	<i>Chelidonium majus</i> L.	Dép. Hérault. Montpellier.	2n = 12		
5986					
6016	<i>Fumaria officinalis</i> L. ssp. <i>officinalis</i>	Dép. Hérault. Montpellier. Diplotaxidetum erucoidis Br.-Bl.	2n = 32		
	Polygonaceae				
	<i>Rumex pulcher</i> L.	Dép. Hérault. Montpellier. Diplotaxidetum erucoidis Br.-Bl.	2n = 20		
5942					
	Ranunculaceae				
	<i>Nigella damascena</i> L.	Dép. Hérault. St. Jean de Védas, 8 km. S.W. of Montpellier, road side.	2n = 12		
5967					
5960	<i>Ranunculus bulbosus</i> L. ssp. <i>bulbosus</i>	Dép. Hérault. Along the road D. 127 between Montpellier and Fiol-le-Fort, 4 km. N. of Murles. Alt. 150 m.	2n = 16		
6000	<i>Ranunculus sardicus</i> Crantz	Dép. Hérault. Montpellier, pool just S.E. of the City.	2n = 16		

Rosaceae								
<i>Potentilla recta</i> L.				6001	Dép. Hérault. Montpellier, small piece of grassland. Ref.: Popoff 1935, Christoff & Papasowa 1943, Mulligan 1959: 2n = 28; Shimotomai 1930, Christoff & Papasowa 1943, Skalinska & Czapik 1959, Gagnieu <i>et al.</i> 1961: 2n = 42.	Dép. Hérault. Montpellier. Brachypodietum phoenicoidis Br.-Bl.	2n = 28	
<i>Sanguisorba minor</i> Scop. ssp. <i>magnolii</i> (Spach) Briq.				5987				2n = 28
Scrophulariaceae								
<i>Antirrhinum orontium</i> L.				5990	Dép. Hérault. Montpellier.			2n = 16
<i>Chaenorhinum organifolium</i> (L.) Lange				5939	D ₂ p. Hérault. Laroque, on the old city walls. Parietarietum murale (Arènes) Br.-Bl.			2n = 14
<i>Linaria supina</i> Desf.				5975	Ref.: Heitz 1927, Champagnat 1952: 2n = 14			
				5992	Dép. Hérault. Le Caylar, dry pasture. Alt. 750 m. Dolomite Ref.: Heitz 1927: 2n = 12			2n = 12
<i>Scrophularia peregrina</i> L.				6015	Dép. Hérault. Montpellier.			2n = 36
Umbelliferae								
<i>Bupleurum baldense</i> Turra				5998	Dép. Hérault. Montpellier, zoo. Alt. 150 m. Garrigues			2n = 16
<i>Ferula communis</i> L. ssp. <i>glauca</i> (L.) Rouy & Camus				6031	Dép. Hérault. Montpellier introduced from Italy. Ref.: Gardé & Malheiros-Gardé 1949: 2n = 22.			2n = 22

Note: Unless otherwise stated, the plants collected in the Dép. Hérault, Montpellier, originate from the S.I.G.M.A. park.

4. NOTES ON SOME SPECIES

The chromosome number of the species *Acanthus mollis* ($2n = 56$), *Anagyris foetida* ($2n = 18$), and *Bupleurum baldense* ($2n = 16$) had not been previously reported.

All the other taxa were previously counted by other workers, most of these counts were carried out with material collected outside France.

Chromosome numbers determined in French material of 43 taxa are the same as the numbers reported earlier by other authors.

Eight species had been studied only once before: *Anacyclus clavatus*, $2n = 18$ (MARTINEZ VASQUEZ 1962); *Carduncellus mitissimus*, $2n = 24$ (DELAY 1969); *Carduus tenuiflorus*, $2n = 54$ (MOORE & FRANKTON 1962); *Ferula communis* ssp. *glauca*, $2n = 22$ (GARDÉ & MALHEIROS-GARDÉ 1949); *Fumana procumbens*, $2n = 32$ (CHIARUGI 1925); *Linaria supina*, $2n = 12$ (HEITZ 1927); *Malcolmia littorea*, $2n = 20$ (MANTON 1932) and *Urospermum dalechampsii*, $2n = 14$ (LARSEN 1956). All these counts could be confirmed.

In three species intraspecific polyploid series appear to occur:

1. *Globularia aphyllanthes* Cr.

The basic number of the genus *Globularia* is $x = 8$ (SCHWARZ 1964). Most species are diploid ($2n = 16$), but also tetraploid ($2n = 32$) and octoploid ($2n = 64$) species occur. SCHWARZ (1964) and LARSEN (1957) reported the number $2n = 16$ for *Globularia aphyllanthes* [based on material collected in France: Dép. Isère, Dép. Bas-Rhin; Austria, Gunspoldskirchen (LARSEN 1957)]. The material from La Couvertoirade proved to be characterized by $2n = 64$, a number which also occurs in the Balearic species *G. cambessedesii* Willk. The material of *G. aphyllanthes* was identified with the key to the species of *Globularia* given by SCHWARZ (1939). The leaves are obtuse or emarginate. When the apex of the leaf is denticulate, the central tooth is always smaller than the lateral ones. The stem leaves are not cuspidate. The involucre scales are broad, not cuspidate, and slightly hairy. The calyx is deeply divided. The plants are very small, only 5 cm. in height.

2. *Festuca spadicea* L.

In several species of the genus *Festuca* intraspecific polyploid series occur. It appears that *F. spadicea* does not form an exception; many authors reported the occurrence of diploid material, MALIK & THOMAS (1966) reported the number $2n = 28$, whereas the material studied by the present authors, collected near Le Caylar, proved to be hexaploid ($2n = 42$).

3. *Potentilla recta* L.

Many *Potentilla* species show intraspecific polyploidy ($x = 7$). In some species, e.g. in *Potentilla anserina*, no diploids were found up till now, only tetraploids and hexaploids have been reported. This is also the case in *Potentilla recta*. The French material turned out to be tetraploid, but many hexaploid plants were found by various authors (see SKALIŃSKA & CZAPIK 1959).

In six species other chromosome numbers were counted than previously reported by other authors:

1. *Silene conica* L.

BLACKBURN & MORTON (1957) reported the number $2n = 24$ for *S. conica*, observed in British material. The results obtained by KHOSHOO & BHATIA (1963) who found $2n = 20$ were confirmed by us. It is remarkable that more than 80 species of the genus have the basic number $x = 12$, whereas only in *S. conica* and *S. conoidea* (which are regarded as conspecific by Khoshoo & Bhatia) the number $2n = 20$ was found.

2. *Lapsana communis* L.

Previous counts in *L. communis* were $2n = 14$ (i.a. based on Dutch material), $2n = 16$ (Finnish material) and $2n = 12$ (Scandinavian material). It seems desirable to extend the cytological studies to plants collected in northern Europe, in order to investigate the distribution of the $2n = 12$ - and the $2n = 16$ -types in this part of the range of the species.

3. *Leuzea conifera* (L.) DC.

Contrary to the results obtained by LORENZO-ANDREU & GARCIA-SANZ (1950) in Spanish material the French plants turned out to be characterized by $2n = 26$.

4. *Erodium ciconium* (Jusl.) L'Hérit.

Our results are in accordance with the observations by WARBURG (1938) who counted $2n = 20$. GUITTONNEAU (1964, 1965 and 1967) reported the number $2n = 18$ for this species, based on Tunesian material. The number $2n = 18$ is a rare number in the genus *Erodium*, the most common one appears to be $x = 10$.

5. *Salvia verbenaca* L.

The numbers $2n = 59$, counted in French material (GADELLA *et al.* 1966) and $2n = 42$ in North African material (REESE 1957), were not found in our French material. GADELLA *et al.* counted $2n = 64$ in Spanish material. This last number could be confirmed by the present authors.

6. *Nothoscordon fragrans* Kunth

Many different chromosome numbers have been reported for *N. fragrans* ($2n = 16, 18, 19, 20, 24, 32$). KHOSHO (1966), who studied plants with the number $2n = 19$, investigated pollen-mitosis and found that the most common numbers in the pollen grains are 9 (41 %) and 10 (43 %), followed by 8 (3 %) and 11 (6 %). The species does not only show numerical differences, but also turned out to be a complex structural heterozygote.

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