

CHROMOSOME NUMBERS OF FLOWERING PLANTS IN THE NETHERLANDS. V

BY

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INTRODUCTION

The present paper, the fifth¹⁾ in this series, is a continuation of the documented list of chromosome numbers of Angiospermae occurring in the Netherlands. In this paper 49 species and two hybrids are listed. Some species show variation in chromosome number, as was concluded after comparison of our results with those of other authors [cf. the lists published by LÖVE and LÖVE (1961); CAVE *et al.* (1956–1964); ORNDUFF (1967, 1968, 1969); SOLBRIG and GADELLA (1970); MOORE (1970)]. Some notes on 14 species and two hybrids are given.

MATERIALS AND METHODS

Some plants were transferred from their natural habitat to the experimental plot, but in many other cases the plants were grown from seeds collected in nature. In all cases roottips were used for the study of metaphase-plates. The roottips were fixed in Karpechenko's fixative, embedded in paraffin, sectioned at 15 micron and stained according to Heidenhain's haematoxylin method. Voucher specimens have been deposited in the Herbarium of the State University of Utrecht.

RESULTS

The results are listed in the table.

The species marked with an asterisk will be discussed in the chapter "Notes on some species".

NOTES ON SOME SPECIES

1. *Symphytum × uplandicum* Nym. ($2n=36$).

GADELLA and KLIPHUIS (1969) showed that the species *S. asperum* Lepech. and *S. officinale* L. are able to intercross. Their hybrid, *S. ×*

¹⁾ Continued from: Acta Bot. Neerl. 12: 195–230. 1963; Proc. Roy. Neth. Acad. Sci. ser. C 69: 541–556. 1966; Proc. Roy. Neth. Acad. Sci. ser. C 70: 7–20. 1967; Proc. Roy. Neth. Acad. Sci. ser. C 71: 168–183. 1968.

	Plant no.	Source of the material	2n
Boraginaceae			
<i>Symphytum × uplandicum</i> Nym. *)	8634-8636	Terziet (Limburg)	36
Caryophyllaceae			
<i>Arenaria serpyllifolia</i> L.	4119	Bergen (Noord-Holland)	40
<i>Cerastium semidecandrum</i> L.	4116	Bergen aan Zee (Noord-Holland)	36
<i>Moehringia trinervia</i> (L.) Clairv.	4126	Bergen (Noord-Holland)	24
<i>Spergula arvensis</i> L. *)	5920	Oosterend, Isle of Terschelling (Friesland)	36
<i>Stellaria alsine</i> Grimm	2978-2980	Norg (Drente)	24
	2314-2317	Terziet (Limburg)	24
<i>Stellaria graminea</i> L. *)	4001	Kootwijkerbroek (Gelderland)	26
	4007	Ermelo (Gelderland)	26
	2845-2847	Houten (Utrecht)	26
	2727-2731	Loosdrecht (Utrecht)	26
	4257	Liempde (Noord-Brabant)	26
	2292-2296	Gulpen (Limburg)	26
	2398-2399	Terziet (Limburg)	26
	s.n.	Utrecht (Utrecht)	39
	2996-2998	Zalk (Overijssel)	52
	2701-2703	Oosterend, Isle of Terschelling (Friesland)	52
<i>Stellaria holostea</i> L.	2987-2990	Norg (Drente)	26
	2955-2958	Rhenen (Utrecht)	26
	2239-2243	Oost-Voorne (Zuid-Holland)	26
	2287-2291	Rijckholt (Limburg)	26
	2309-2313	Gulpen (Limburg)	26
<i>Stellaria media</i> (L.) Vill. *)	2678-2682	Oosterend, Isle of Terschelling (Friesland)	40, 42
	2732-2736	Utrecht (Utrecht)	40
	2705-2706	Loosdrecht (Utrecht)	40, 42
	2942-2944	Rhenen (Utrecht)	40, 42
<i>Stellaria nemorum</i> L. ssp. <i>nemorum</i>	2660	Epen (Limburg)	26
	2661	Wijlre (Limburg)	26
<i>Stellaria palustris</i> (Murr.) Retz. *)	3109, 3111	Sleen (Drente)	174
	2991	Kampen (Overijssel)	188
	2992	idem	179
	2993	idem	182
	2994	idem	176
	2995	idem	180
	4409	Oud-Zevenaar (Gelderland)	175
	2672	Loosdrecht (Utrecht)	176
<i>Stellaria pallida</i> Piré *)	2567-2568	Boschplaat, Isle of Terschelling (Friesland)	22
	2162-2164	Groet (Noord-Holland)	22
	2245	Oost-Voorne (Zuid-Holland)	22
Cruciferae			
<i>Arabidopsis thaliana</i> (DC) Heynh.	6678	Doorn (Utrecht)	10
Compositae			
<i>Erigeron canadensis</i> L.	7875	Rhenen (Utrecht)	18
<i>Hieracium auricula</i> L. *)	9343-9345	Vaals (Limburg)	18
<i>Hieracium bauhinii</i> Bess.	6650-8652	Terziet (Limburg)	45
	8637	Brunssum (Limburg)	45

	Plant no.	Source of the material	2n
<i>Hieracium peleterianum</i> Mérat	5786-5789	Hoorn, Isle of Terschelling (Friesland)	18
<i>Hieracium pilosella</i> L. *)	4448-4454	Heelsum (Gelderland)	36
	5747-5757	West-Terschelling, Isle of Terschelling (Friesland)	45
	7801-7805	Isle of Vlieland, Meeuwenduinen (Friesland)	45
	6730-6731	Isle of Texel, de Muy (Noord-Holland)	45
	7846-7850	Oost-Vlieland, Isle of Vlieland (Friesland)	54
	7953; 7959	Isle of Texel, de Slufter (Noord-Holland) (other plants in the same population: 2n = 36, 2n = 45)	54
<i>Inula conyzoides</i> DC.	8787	Brunssum (Limburg)	32
<i>Leontodon nudicaulis</i> (L.) Banks ex Lowe	7448; 7453	Oosterend, Isle of Terschelling (Friesland)	8
<i>Tragopogon pratensis</i> L.	4194	Cromvoirt (Noord-Brabant)	12
Gramineae			
<i>Aira caryophyllea</i> L.	4196	Ommen (Overijssel)	14
<i>Apera spica-venti</i> (L.) P.B.	4185	Helvoirt (Noord-Brabant)	14
<i>Briza media</i> L.	4195	Cromvoirt (Noord-Brabant)	14
<i>Bromus mollis</i> L.	4123	Bergen aan Zee (Noord-Holland)	28
<i>Bromus tectorum</i> L.	4121	Bergen aan Zee (Noord-Holland)	14
	4315	Oost-Voorne (Zuid-Holland)	14
<i>Festuca ovina</i> L. *)	8072	Cottessen (Limburg)	28
<i>Sieglingia decumbens</i> (L.) Bernh.	4314	Oost-Voorne (Zuid-Holland)	36
Labiatae			
<i>Lamium purpureum</i> L. *)	7852	Utrecht (Utrecht)	18
<i>Thymus pulegioides</i> L.	7877	Rhenen (Utrecht)	28
Papilionaceae			
<i>Ononis spinosa</i> L.	7445	Oosterend, Isle of Terschelling (Friesland)	30
<i>Trifolium fragiferum</i> L.	7447	Oosterend, Isle of Terschelling (Friesland)	16
Plantaginaceae			
<i>Plantago lanceolata</i> L.	8218-8219	Venlo (Limburg)	12
Polygonaceae			
<i>Rumex obtusifolius</i> L.	6230	Sliedrecht (Zuid-Holland)	40
Primulaceae			
<i>Lysimachia vulgaris</i> L. *)	5901	Oosterend, Isle of Terschelling (Friesland)	42
Ranunculaceae			
<i>Thalictrum flavum</i> L.	6218	Sliedrecht (Zuid-Holland)	84
Rosaceae			
<i>Potentilla anglica</i> Laich.	7965-7969	Isle of Texel (Noord-Holland)	56
	10.106	Isle of Schiermonnikoog (Friesland)	56
<i>Potentilla anserina</i> L. *)	2227-2232	Odoorn (Drente)	28
	2284-2286	Sleen (Drente)	28
	2168-2176	Camperduin (Noord-Holland)	28
	2342-2346	Epen (Limburg)	28

	Plant no.	Source of the material	2n
<i>Potentilla argentea</i> L. *)	2080-2086 2905-2914 2713-2715 4463-4479 6501 6051-6058 6050-7104 2710-2711 6584-6596	Ellecom (Gelderland) Beusichem (Gelderland) Oud-Loosdrecht (Utrecht) Heelsum (Gelderland) Rhenen (Utrecht) Hollandse Rading (Utrecht) Hilversum (Noord-Holland) Bussum (Noord-Holland) Bussum (Noord-Holland) in the same population two plants:	42 42 42 14 14 14 14 42 42 14
<i>Potentilla erecta</i> (L.) Räuschel	s.n. 2329-2332	Hilversum (Noord-Holland) Bemelen (Limburg)	28 28
<i>Potentilla intermedia</i> L. <i>Potentilla × mixta</i> Nolte ex Koch *)	6601-6620 2668-2670 2132-2139	Den Dolder (Utrecht) Bilthoven (Utrecht) Uitweg (Utrecht)	56 42 42
<i>Potentilla norvegica</i> L.	4720-2722 7089-7103 8785 2717 2817-2818	Hilversum (Noord-Holland) idem Brunssum (Limburg) Loosdrecht (Utrecht) Westenschouwen (Zeeland)	70 70 70 28 28
<i>Potentilla reptans</i> L.	2652 2320-2325 2579 2602	Gulpen (Limburg) Wijlre (Limburg) Epen (Limburg) Terziet (Limburg)	28 28 28 28
<i>Potentilla sterilis</i> (L.) Garcke	1922-1931 1976-1982 2330-2332	Oost-Voorne (Zuid-Holland) Oost-Voorne (Zuid-Holland) Bemelen (Limburg)	42 42 42
<i>Potentilla tabernaemontani</i> Aschers.			
Scrophulariaceae			
<i>Scrophularia nodosa</i> L.	6644 6231	Amelte (Drente) Sliedrecht (Zuid-Holland)	36 36
<i>Veronica officinalis</i> L.	7452	Oosterend, Isle of Terschelling (Friesland)	36
Umbelliferae			
<i>Pimpinella saxifraga</i> L. *)	4099	Bergen (Noord-Holland)	36
Urticaceae			
<i>Urtica dioica</i> L.	8075	Epen (Limburg)	52
Valerianaceae			
<i>Valerianella locusta</i> (L.) Betcke *)	8398	De Koog, Isle of Texel (Noord-Holland)	16

uplandicum, is fairly common in various regions of Europe, notably in England, Ireland and S. Scandinavia. In the Netherlands the hybrid is rare. The plants from Terziet clearly showed intermediate characters: the size of the plants rather large, the leaves not decurrent and the colour of the corolla bluish (purple in bud).

Experimentally produced hybrids between *S. officinale* ($2n=40$) and *S. asperum* ($2n=32$) completely agree with the plants from Terziet. Hybrids between *S. officinale* ($2n=48$) and *S. asperum* ($2n=32$), which

are characterized by the chromosome number $2n=40$ and by pink flower buds, have not been found in the Netherlands up till now.

2. *Spergula arvensis* L. ($2n=36$).

Various authors (cf. Löve and Löve, 1961) counted $2n=18$ in this species, whereas the plants from Oosterend (Isle of Terschelling) turned out to be tetraploid ($2n=36$).

3. *Stellaria graminea* L. ($2n=26$, 39, 52).

Many plants collected near Oosterend (Isle of Terschelling) are tetraploid. A preliminary study revealed that the differences between the diploid plants, which are very common in the Netherlands, and the tetraploids from Zalk and Terschelling are not very clear (Groet, unpublished). Biometric investigations on a larger scale seem to be necessary. Also the sterile triploid plants (found on the University Campus "de Uithof" near Utrecht) deserve a closer examination.

4. *Stellaria media* (L.) Vill. ($2n=40$, 42) and *Stellaria pallida* Piré. ($2n=22$).

Stellaria media is a hypotetraploid species (in most plants the numbers $2n=40$ and $2n=42$ are counted in the same roottip), whereas *S. pallida* is diploid ($2n=22$). In the opinion of the present authors it seems advisable to regard *S. media* and *S. pallida* as distinct species. They differ in morphological respect, have different chromosome numbers and have a different ecological preference. Moreover, PETERSON (1936) showed that *S. pallida* and *S. media* are separated by sterility barriers. For that reason the treatment of *S. pallida* as a subspecies of *S. media* does not seem to be justified.

5. *Stellaria palustris* (Murr.) Retz.

The chromosome number of this species is very high. In the best stained and fixed metaphaseplates the numbers $2n=174$, 175, 176, 180, 182 and 188 were counted by Miss I. Groet and the present authors. PETERSON (1936) and BLACKBURN and MORTON (1957) reported the number $2n=\text{ca. } 130$. It seems probable that the basic number of this species is $X=13$, since many other more or less similar species of the genus *Stellaria* are characterized by this basic number. This may indicate that the Dutch plants are ca. 14-ploid. The exact 14-ploid number is $2n=182$, a number which could be demonstrated with certainty in one plant collected near Kampen, (Overijssel).

6. *Hieracium auricula* L. ($2n=18$).

In accordance with most previous counts the present authors counted $2n=18$. Only in one case (CONTANDRIOPoulos, 1957) triploid material was found (Corse, vallée de la Restonica).

7. *Hieracium pilosella* L. ($2n=36, 45, 54$).

The results, presented in this paper, agree with those of other authors (TURESSON and TURESSON, 1960; SKALIŃSKA, 1968; GADELLA, KLIPHUIS and KRAMER, 1970).

De Wit (unpublished) counted many plants in the Netherlands and found the numbers $2n=36, 45$ and 54 . Plants with $2n=36$ are very common in the Netherlands. They reproduce sexually. The plants with $2n=45$ seem to be less common, at least in various areas of the Netherlands. The plants with $2n=54$ are very rare. One population was found near Oost-Vlieland, (West-Frisian Isle of Vlieland). A large population near "de Slufter" (Isle of Texel) consisted of many tetraploid plants ($2n=36$), but two pentaploids ($2n=45$) and 2 hexaploids ($2n=54$) were also met with. The Dutch plants all belong to the group *Hieracium eu-pilosella*, characterized by the non-floccose upperside of the leaves.

In a small population near Formerum (Isle of Terschelling) two triploid plants were found ($2n=27$). These plants produced achenes, which did not germinate. Apparently these plants are sterile. The other plants in this population turned out to be diploid ($2n=18$) and belong to *H. peleterianum* Mérat. The runners of the triploid plants are somewhat more slender than those of *H. peleterianum*, indicating that the plants concerned are possibly hybrids between *H. peleterianum* ($2n=18$) and *H. pilosella* ($2n=36$). At a distance of 200 m. a large population of tetraploid plants of *H. pilosella* was found, which may lend support to the supposed hybrid origin of the triploids.

8. *Festuca ovina* L. ($2n=28$).

The plants from Cottessen (Limburg) grow in a meadow of which the soil is rich in zinc, along the rivulet "de Geul". They have the characters of the subspecies *ovina* and are tetraploid ($2n=28$). The leaves are glaucous. Plants belonging to the subspecies *tenuifolia* (Sibth.) Čelak., turned out to be diploid, $2n=14$ and were collected near Speuld (GADELLA and KLIPHUIS, 1968). This subspecies is often considered as a separate species: *Festuca tenuifolia* Sibth. The diploids and tetraploids do not cross in nature according to WATSON (1958), which supports the treatment of both taxa as species.

9. *Lamium purpureum* L. ($2n=18$).

A white-flowering form, collected near Utrecht by Mr. F. Neijenhuijs, proved to have the same chromosome number as the purple flowering form: $2n=18$.

10. *Lysimachia vulgaris* L. ($2n=42$).

This species varies cytologically: $2n=28$ (LEVITSKY, in TISCHLER, 1937), $2n=56$ (GADELLA and KLIPHUIS, 1963, 1966) and $2n=84$ (GADELLA and KLIPHUIS, 1968). The number $2n=84$ is the more common in the

Netherlands. In the eastern part of the Isle of Terschelling various plants were found with the number $2n=42$. The basic number seems to be $X=7$. The distribution of the cytotypes and the morphological differences between them should be studied more in detail.

11. *Potentilla anserina* L. ($2n=28, 42$).

Tetraploid and hexaploid plants were found in the Netherlands. The hexaploid plants differ slightly from the tetraploids (Miss. L. Offers, unpublished). The data obtained from Dutch material completely agree with those obtained by Rousi (1965). One of the most striking features is the absence of ripe fruits in the hexaploids. This, however, could not always be observed in British material (OCKENDON and WALTERS, 1970), but all Dutch hexaploids lack ripe fruits, not only in the field, but also after several years of experimental cultivation. The observations on the Dutch material, are restricted to three populations both in the field and under experimental cultivation, whereas plants of three other populations, studied in nature, also turned out to be sterile and hexaploid.

12. *Potentilla argentea* L. ($2n=14, 42$).

The habit of the diploid plants ($2n=14$) is prostrate, of the hexaploid plants ($2n=42$) erect. The diploid plants should be assigned to *P. argentea* L., the hexaploids to *P. neglecta* Baumg. (Flora Europaea II, p. 41. 1968). The correlation of the other characters (number of teeth of the leaflets; length of the petals; indument of the leaves) with the chromosome number does not seem to be perfect. The Dutch material needs a closer examination on a much larger scale.

13. *Potentilla × mixta* Nolte ex Koch ($2n=42$).

This hybrid was found in two places in the province of Utrecht. It originated by the cross *P. anglica* ($2n=56$) \times *P. reptans* ($2n=28$). The plants differ from the tetraploid *reptans* in being sterile, in their usually dichotomously branched runners and in the leaves, which have usually three instead of five leaflets. The plants completely agree with the description given by CZAPIK (1968) for Polish material.

14. *Pimpinella saxifraga* L. ($2n=36$).

In the genus *Pimpinella* two basic numbers occur: $X=9$ and $X=10$. In the species *Pimpinella major* (L.) Huds. and *Pimpinella saxifraga* L. both basic numbers are met with, in the first species on the diploid level: $2n=18, 20$, (HÅKANSSON, 1953; BAKSAY, 1957) in the second species on the tetraploid level: $2n=36, 40$, (HÅKANSSON, 1953; BELL and CONSTANCE, 1960).

15. *Valerianella locusta* (L.) Betcke ($2n=16$).

The plants from de Koog (Isle of Texel) have the chromosome number

$2n=16$. Previous counts on this species yielded the following results: $2n=14$ (ELVERS, 1932); $2n=15, 16, 17, 18$ (aneusomaty, different chromosome numbers in roottips of the same individual; the material was collected on the slope of the Grebbeberg near Rhenen, Utrecht, by GADELLA and KLIPHUIS, 1967).

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REFERENCES

- BAKSAY, L., The chromosome numbers and cytotaxonomical relations of some European plant species. Ann. Hist.-Nat. Mus. Natl. Hung. S.N. 8, 169–174 (1957).
- BELL, C. R. and L. CONSTANCE, Chromosome numbers in Umbelliferae II. Am. Jour. Bot. 47, 24–32 (1960).
- BLACKBURN, K. B. and J. K. MORTON, The incidence of polyploidy in the Caryophyllaceae of Britain and Portugal. New Phytol. 56, 344–352 (1957).
- CAVE, M. S. et al., Index to Plant Chromosome Numbers for 1956–1964. Chapel Hill, North Carolina.
- CONTANDRIOPoulos, J., Nouvelle contribution à l'étude caryologique des endémiques de la Corse. Bull. Soc. Bot. France 104, 533–538 (1957).
- CZAPIK, R., Karyological studies on *Potentilla reptans* L. and *P. mixta* Nolte. Acta Biol. Cracov. 11, 187–197 (1968).
- ELVERS, I., Chromosomenzahlen in der Gattung *Valerianella* nebst einigen systematischen Bemerkungen. Acta Horti Berg. 11, 81–87 (1932).
- GADELLA, Th. W. J. and E. KLIPHUIS, Chromosome numbers of flowering plants in the Netherlands. Acta Bot. Neerl. 12, 195–230 (1963).
- _____, and _____, idem II. Proc. Roy. Neth. Acad. Sci. ser. C, 69, 541–556 (1966).
- _____, and _____, idem III. Proc. Roy. Neth. Acad. Sci. ser. C, 70, 7–20 (1967).
- _____, and _____, idem IV. Proc. Roy. Neth. Acad. Sci. ser. C, 71, 168–183 (1968).
- _____, and _____, Cytotaxonomic studies in the genus *Symphytum* II. Crossing experiments between *Symphytum officinale* L. and *Symphytum asperum* Lepech. Acta Bot. Neerl. 18, 544–549 (1969).
- _____, and K. U. KRAMER, Zytotaxonomische Untersuchungen an Blütenpflanzen aus dem Osten Österreichs. Wiss. Arbeiten Burgenland 44, 187–194 (1970).
- HÅKANSSON, A., Some chromosome numbers in Umbelliferae. Bot. Not. 301–307 (1953).
- LÖVE, Á. and D. LÖVE, Chromosome numbers of Central and Northwest European plant species. Opera Bot. Lund 5, 1–581 (1969).
- MOORE, R. J. (ed.), Index to Plant Chromosome Numbers for 1968. Regnum Vegetabile 68, 1–115 (1970).
- OCKENDON, D. J. and S. M. WALTERS, Studies in *Potentilla anserina* L. Watsonia 8, 135–144 (1970).
- ORNDUFF, R. (ed.), Index to Plant Chromosome Numbers for 1965. Regnum Vegetabile 50, 1–128 (1967).

- ORNDUFF, R. (ed.), idem for 1966. *Regnum Vegetabile* 55, 1–126 (1968).
_____, idem for 1967. *Regnum Vegetabile* 59, 1–129 (1966).
PETERSON, D., *Stellaria-Studien. Zur Zytologie, Genetik, Ökologie und Systematik der Gattung Stellaria ins besondere der media-Gruppe.* Bot. Not., 281–419 (1936).
ROUSI, A., Biosystematic studies on the species aggregate *Potentilla anserina* L. *Ann. Bot. Fenn.* 2, 47–112 (1965).
SKALIŃSKA, M., Cytological analysis of some *Hieracium* species, subgenus *Pilosella* from mountains in Southern Poland. *Acta Biol. Cracov.* 10, 127–142 (1968).
SOLBRIG, O. and T. W. J. GADELLA, Contributions to a biosystematic literature index (1945–1964). *Regnum Vegetabile* 69, 1–566 (1970).
TISCHLER, G., *Tab. Biol.* 12, 57–115 (1937).
TURESSON, G. and B. TURESSON, Experimental studies in *Hieracium pilosella* L. I. Reproduction, chromosome number and distribution. *Hereditas* 46, 717–736 (1960).
WATSON, J., The distribution in Britain of diploid and tetraploid races within the *Festuca ovina* group. *New Phytol.* 57, 11–18 (1958).