

Chromosome numbers of *Potentilla* subsect. *Collinae* (*Rosaceae*) from Poland

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Abstract — The structure of the karyotype is proposed for *Potentilla* subsect. *Collinae* Juz. There are not the marker chromosomes characteristic for studied taxa of this subsect. of karyotaxonomic meaning. For taxa of *P.* subsect. *Collinae*: *P. wimanniana* Günther et Schummel ($2n = 35$) and *P. leucopolitana* var. *schultzei* f. *koernickei* T. Wolf ($2n = 35$), the number of chromosomes are reported for the first time. Chromosome numbers for the following taxa of this subsect. from Poland: *P. collina* Wibel s. *stricto* ($2n = 35$) and *P. leucopolitana* P.J. Müller ($2n = 35$) are counted for the first time. Chromosome numbers are found in taxa related to *P.* subsect. *Collinae*, i.e. *P. incana* P. Gaertner, B. Meyer & Scherb. ($2n = 28$) and *P. argentea* L. ($2n = 35$). In seedlings of *P. thyrsoiflora* Hülsen ex Zimmeter, from among three noted chromosome numbers $2n = 21, 28$ and 35 there is not one dominant.

Key words: chromosome numbers, polisomaticity, *Potentilla collina* s.l., *Rosaceae*.

INTRODUCTION

Potentilla subsect. *Collinae* Juz. belongs to critical and systematically difficult plant taxa due to its changeability and the consequent diversity of forms (SZAFER and PAWŁOWSKI 1955). The causes of this changeability are probably hybrid origin this taxon from different crosses between *P. argentea* L. on the one hand and *P. incana* P. Gaertner, B. Meyer & Scherb. *P. tabernaemontani* Ascherson on the other, the occurrence of polyploids and ability to reproduce both sexually and apomictically (MÜNTZING 1928; 1958a; ASKER and FRÖST 1970; ASKER 1971; HOLM and GHATNEKAR 1996; GREGOR *at al.* 2002). Hence, the division of this species aggregate which comprises several forms considered by some authors for species, while by others as subspecies or their variants according to exclusively morphological criteria, is difficult and controversial. Differences between apomictic microspecies as agamic species are most often slight, but usually stable. Because agamic taxa are more stable than microspecies of self-fertilizing taxa,

there is a temptation to ascribe the rank of taxonomic species for apomictic microspecies.

The genus *Potentilla* belongs to the family *Rosaceae*, in which polyploids are common. In Table 1 nine taxa of *P.* subsect. *Collinae* are listed. The chromosome numbers are multiples of seven, the basic number in the genus *Potentilla*.

Several chromosome counts have been published for *P. argentea* $2n = 14, 28, 35, 42$ and 56 (MÜNTZING 1928; 1931; MÜNTZING and MÜNTZING 1941; 1942; SKALIŃSKA 1950; SKALIŃSKA and CZAPIK 1958), and *P. incana* $2n = 28, 35, 42$ and 56 (= *P. arenaria* Borkh.) (SKALIŃSKA 1950; BAKŠAY 1956; SKALIŃSKA and CZAPIK 1958; RUTISHAUSER 1960).

Till today, chromosome numbers in the taxa of *P.* subsect. *Collinae* from the area of Poland were not determined despite cytological research having been carried out on other species of the genus (POGAN and WCISŁO 1990).

Thus, cytological investigations on the *P.* subsect. *Collinae* as well as on its two closely related species - *P. incana* and *P. argentea* were needed.

MATERIAL AND METHODS

In the present study 7 taxa: *P. collina* Wibel s.str.; *P. thyrsoiflora* Hülsen ex Zimmeter; *P. wiman-*

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Table 1 — Somatic chromosome numbers of taxa in the *Potentilla* subsect. *Collinae* based on literature data.

Taxa	2n	Geographic origin	Reference
<i>P. alpicola</i> De la Soie	42	Germany	Gregor <i>et al.</i> (2002)
<i>P. alsatica</i> T. Gregor	42	Germany	Gregor (2004)
<i>P. argenteiformis</i> Kauffm.	42	Origin of plants unknown	Bolkhovskikh <i>et al.</i> (1969)
<i>P. collina s. lato</i>	35	The Botanical Garden Lyon, France	Müntzing (1928), (1931), (1958)
	35	The Botanical Garden Uppsala, Sweden	Müntzing (1931)
	42, ±56, ±62	Gotland and Öland, Sweden	Müntzing (1928), (1931), (1958)
	±62	Ottenby, Sweden	Müntzing (1958)
	35	Podunajska Lowland, Slovakia	Uhriková <i>et al.</i> (1986)
	35–84	Scandinavia	Lid (1987)
<i>P. leucopolitana</i> P. J. Müller	42	Germany	Gregor <i>et al.</i> (2002)
<i>P. lindackeri</i> Lausch	42	Czech Republic	Gregor <i>et al.</i> (2002)
<i>P. praecox</i> F. W. Schulz	42	Germany	Rutishauser (1943), Gregor <i>et al.</i> (2002)
<i>P. sterneli</i> T. Gregor & Karlsson <i>sp. nova</i>	42	Gotland, Öland, Blekinge and Szaland, Sweden	Gregor and Karlsson (2007)
<i>P. wisnariensis</i> T. Gregor & Henker	42	Germany	Gregor and Henker (2001)

niana Günther et Schummel; *P. leucopolitana* P.J. Müller; *P. leucopolitana* var. *schultzei* f. *koernickei* Th. Wolf; *P. incana* P. Gaertner, B. Meyer & Scherb. and *P. argentea* L. were examined. The studied plant material was collected during field trips in Poland and cultivated in experimental garden (Table 2). Adult individual or seedlings (always originated from seeds of one adult specimen) were investigated. One or three, in case of *P. incana*, individuals of each taxon from a locality were investigated. Chromosome counts were made using root tips of adult plants and seedlings. Seedlings were grown from seeds of plants transferred from natural populations to the experimental garden.

The root tips were incubated in saturated water solution of α - bromonaphtalene overnight at 4°C and fixed in 1:3 acetic acid: ethanol. Then they were hydrolyzed with 1N HCl at 60°C and squashed in 45% acetic acid. The chromosomes were stained with 0.1 % aqueous solution of toluidine blue.

Some of the plants investigated were preserved in the form of herbarium specimens and deposited in the Department of Geobotany and Plant Ecology of the University of Łódź. Others were transplanted into the experimental garden for further studies.

The preparations were analysed under a Nikon Optiphot - 2 microscope. The chromosomes were captured using Multiscan (Computer Scanning

Systems Ltd.) software. For chromosome analyses and statistical calculations the MR Karyo program (JOACHIMIĄK and TOKARSKI) was used.

Nomenclature of taxa according to WOLF (1908) and KURTTO *et al.* (2004) and for centromeric position on chromosomes according to LEVAN *et al.* (1964) was used.

RESULTS AND DISCUSSION

Chromosomes of *Potentilla* subsect. *Collinae* are small (between ca. 0.9 and 1.5 μ m), the centromeres are located in median to submedian positions. The basic number is $x = 7$ (Fig. 1, 2; Table 3). There are not the marker chromosomes characteristic for studied taxa of *P.* subsect. *Collinae* of karyotaxonomic meaning. From this reason the structure of the karyotype is proposed for whole subsect. (Fig. 2). Four chromosome numbers ($2n = 21, 28, 35$ and 42) are reported for taxa from *P.* subsect. *Collinae* (Table 2). Tetraploid and pentaploid seedlings are found for *P. collina s. stricto*, the pentaploid represents the most common type (Fig. 1a). The pentaploid somatic number was reported previously by MÜNTZING (1931; 1958a) and UHRIKOVÁ *et al.* (1986). Other chromosome counts ($42, \pm 56$ and ± 62) were found for the *P. collina s. stricto* by MÜNTZING (1931; 1958a). In four polisomatic seedlings of *P. thyrsiflora* three chromosome numbers: 21, 28 and 35 are noted.

Table 2 — Somatic chromosome numbers (2n) determined for 5 taxa belonging to the *Potentilla* subsect. *Collinae* and of the related species *P. incana* and *P. argentea* (underlined numbers are the predominant 2n numbers for a taxon).

Taxa	Vegetable material	2n	Geographic origin	ATPOL*
<i>P. collina s. stricto</i>	young seedlings	28, 35	Kłobuck 50°57'N, 18°59'E, 20.VI.2000 J. Kołodziejek	DF62
	young seedlings	28, 35	Rzędkowice 50°35'N, 19°27'E, 15.VII.2001 J. Kołodziejek	DF06
	young seedlings	28, 35	Mirów 50°07'N, 19°28'E, 17.VII.2000 J. Kołodziejek	DF06
<i>P. thyrsoiflora</i>	young seedlings	21, 28, 35	Cisowa near Pilica 50°26'N, 19°42'E, 4.VI.2001 J. Kołodziejek	DF27
<i>P. wimanniana</i>	young seedlings	35	Cisowa near Pilica 50°26'N, 19°42'E, 4.VI.2001 J. Kołodziejek	DF27
	adult plant	28, 35	Mirów 50°37'N, 19°28'E, 17.VII.2000 J. Kołodziejek	DF06
<i>P. leucopolitana</i>	young seedling	35	Chałupy 54°43'N, 18°23'E, 10.VIII.1999, J. Kołodziejek	CA49
<i>P. leucopolitana</i> var. <i>schultzii</i> f. <i>koernickei</i>	young seedlings	28, 35, 42	Czarna Woda near Czersk 53°51'N, 18°08'E, 3.VIII.2003 J. Kołodziejek	CB47
<i>P. argentea</i>	young seedlings	35	Cisowa near Pilica 50°37'N, 19°28'E, 4.VI.2001 J. Kołodziejek	DF27
<i>P. incana</i>	adult plant	28	Ojców 50°14'N, 19°50'E, 17.V.2005 J. Kołodziejek	DF58

* cartographic square in Poland – ATPOL (Zajac 1978)

Table 3 — Averaged numerical data from measurements of chromosomes *Potentilla collina* subsect. *Collinae* from Poland (localization of centromere: m – median region, sm – submedian region; () – standard deviation).

chromosome type	total length (µm)	longer arm (µm)	shorter arm (µm)	arm ratio	centromere localization
1	1.53 (0.12)	0.84 (0.07)	0.69 (0.09)	1.20 (0.20)	m
2	1.39 (0.11)	0.88 (0.07)	0.51 (0.08)	1.71 (0.30)	sm
3	1.27 (0.10)	0.69 (0.07)	0.57 (0.06)	1.21 (0.18)	m
4	1.20 (0.08)	0.67 (0.06)	0.53 (0.06)	1.26 (0.18)	m
5	1.16 (0.10)	0.67 (0.09)	0.50 (0.05)	1.34 (0.24)	m
6	1.05 (0.10)	0.57 (0.06)	0.48 (0.06)	1.18 (0.15)	m
7	0.88 (0.11)	0.51 (0.08)	0.37 (0.07)	1.37 (0.35)	m

Two seedlings have the somatic number $2n = 28$, 35, and two $2n = 21$, 28. None of the established chromosome numbers is distinctly prevalent in investigated material. Also the tetraploid and pentaploid numbers are reported for *P. wimanniana*, but the latter number dominate in this material. In roots of an adult plant of the latest taxon polysomaticity ($2n = 28, 35$ – Fig. 1b i c) is observed. The seedlings of *P. leucopolitana* are pentaploid with $2n = 35$ (Fig. 1d). Most seedlings of *P. leucopolitana* f. *koernickei* have similar counts with $2n = 35$ but some of them are tetraploid $2n = 28$ and hexaploid $2n = 42$. In addition to that, one seedling of the form *koernickei* is polysomatic with two somatic chromosome numbers $2n = 28$

and $2n = 35$. The hexaploid level was reported for *P. leucopolitana* from Germany (GREGOR *et al.* 2002). Chromosome counts are found for *P. thyrsoiflora*, *P. wimanniana* and *P. leucopolitana* f. *koernickei* from all over the world and for *P. collina s. stricto* and *P. leucopolitana* from Poland for the first time.

In seedlings derived from seeds of a single plant, usually 2 or 3 numbers of $2n$ can be calculated (Table 2). Additionally, polysomaticity as intra-individual variation which is observed in roots of *P. thyrsoiflora*, *P. wimanniana* and *P. leucopolitana* f. *koernickei* described in several genera, lastly in *Bromus* and *Caltha* (KULA 1999; CIEŚLAK *et al.* 2000; JOACHIMIĄK *et al.* 2001).

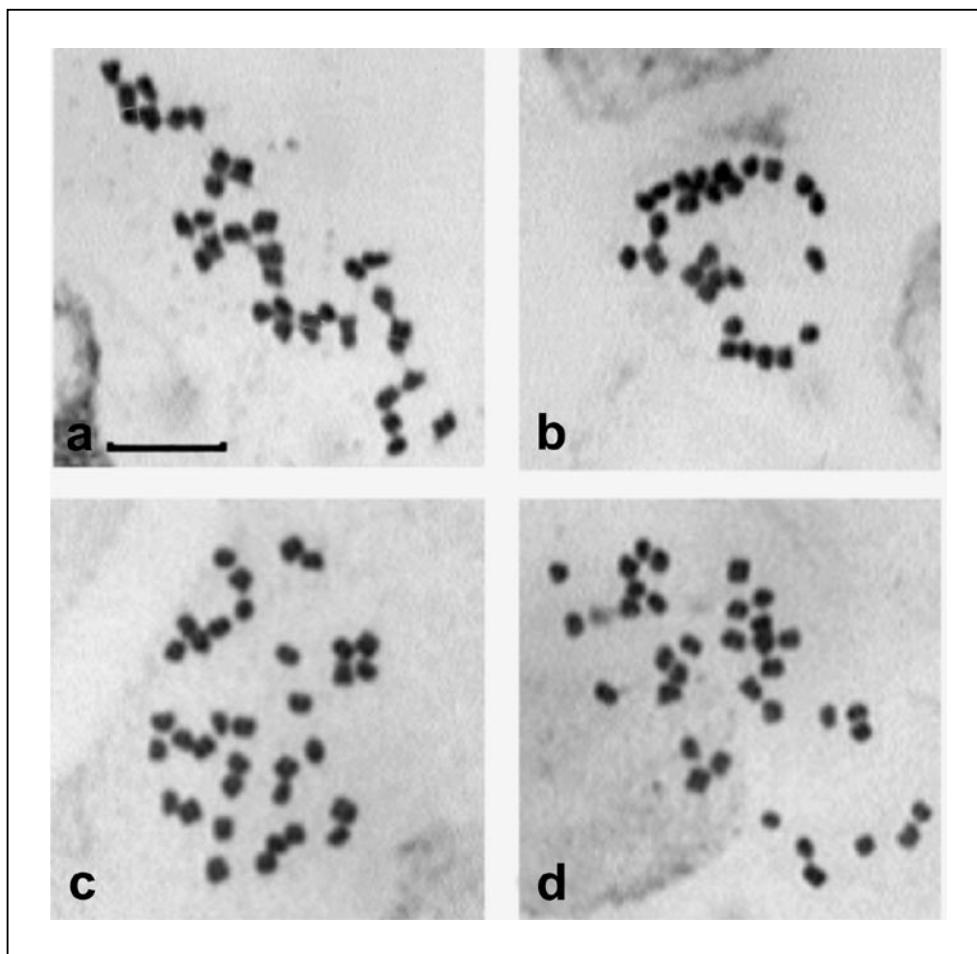


Fig. 1 — Metaphase plates of taxa of *Potentilla* subsect. *Collinae* stained with 0.1% water solution of toluidine blue (a — *P. collina* s. stricto $2n = 35$, b — *P. wimanniana* $2n = 28$, c — *P. wimanniana* $2n = 35$ and d — *P. leucopolitana* $2n = 35$). — bar = 5 μm .

The pentaploidal number $2n = 35$, dominant in the *P.* subsect. *Collinae* suggests that this subsect. is of a hybrid origin in Poland, having an odd number of genomes. Apart from that, some karyological variability and weak differences between taxa of the investigated subsect, together with the lack of genetic barriers (MÜNTZING 1958a; ASKER and FRÖST 1970) presumably mean that *P.* subsect. *Collinae* like e.g. *Caltha palustris* is a young evolutionary taxon (HOFFMAN 1999).

The tetraploid chromosome number is reported for *P. incana*. It agrees with the results of SKALIŃSKA (1950) and SKALIŃSKA and CZAPIK (1958). All investigated seedlings of *P. argentea* have the pentaploid chromosome number ($2n = 35$). In several biotypes of *P. argentea* chromosome numbers $2n = 14, 28, 35, 42$ and 56 were reported (MÜNTZING 1928; 1931; MÜNTZING and MÜNTZING 1941; 1942; SKALIŃSKA 1950; SKALIŃSKA and

CZAPIK 1958). According to MÜNTZING (1958b), the diploids and hexaploids represent the most common types in Scandinavia. In Poland, the hexaploid type of *P. argentea* predominates under investigation by SKALIŃSKA and CZAPIK (1958).

The chromosome numbers for specimens of *P. argentea* ($2n = 35$) and *P. incana* ($2n = 28$) are determined for new localities and correspond to previous results (SKALIŃSKA 1950; SKALIŃSKA and CZAPIK 1958).

The chromosome numbers reported here, together with other studies (e.g. the detailed structure of karyotype) to be carried out in the future, may help in further elucidating the taxonomic relationships between *P.* subsect. *Collinae* and its closely related taxa.

Acknowledgments — In memory of Professor Romana Czapiak, which studied genus *Potentilla*. We are

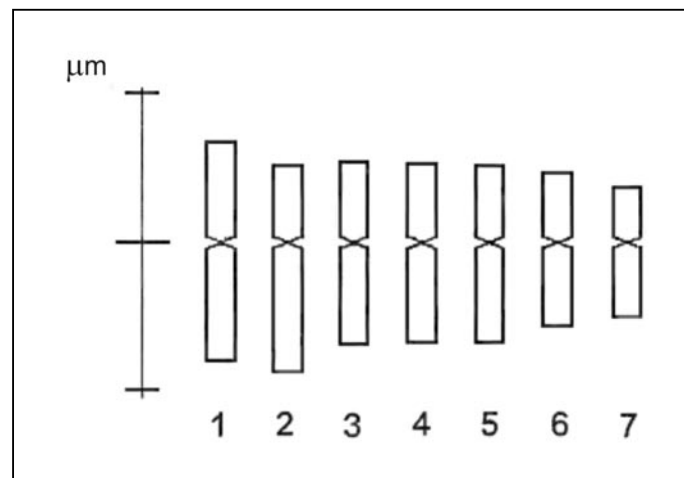


Fig. 2 — Idiogram of *Potentilla* subject. *Collinae*.

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