Folia Geobotanica 34: 373–376, 1999

AUTOGAMY IN *HIERACIUM* SUBGEN. *PILOSELLA*

Anna Krahulcová, Jindřich Chrtek & František Krahulec

Institute of Botany, Academy of Sciences of the Czech Republic, CZ-252 43 Průhonice, Czech Republic; fax +420 2 67750031, E-mail krahulcova@ibot.cas.cz

Keywords: Foreign pollen, Mentor effects, Seed reproduction, Crossing, Self-incompatibility

Abstract: The presence of autogamy in *Hieracium* subgen. *Pilosella* is reported for diploid *H. lactucella* and tetraploid *H. pilosella*. Self-compatibility is induced under the influence of pollen from another species (mentor effects).

Sexual species (or cytotypes) of the *Hieracium* subgen. *Pilosella* (HILL) GRAY have, until now been considered as strictly self-incompatible under field conditions, requiring cross-pollination for seed reproduction (GADELLA 1984, 1987). GADELLA (1984) detected this mode of reproduction in several European species: *H. castellanum* BOISS. et REUT., *H. hoppeanum* SCHULT., *H. lactucella* WALLR., *H. peleterianum* MÉRAT – all diploids; *H. pilosella* L. – diploid, tetraploid and some of the hexaploid cytotypes; and tetraploid *H. piloselloides* VILL. His conclusion was based on the results of pollination experiments, in which all the species and races mentioned above produced seeds in open-pollinated capitula only, while isolated, or emasculated and isolated capitula have developed no seeds. However, the earlier crossing experiments undertaken by CHRISTOFF (1942), have shown the possible autogamous seed reproduction in *H. lactucella* under conditions of hybrid cross-pollination. This author has recorded both matroclinal (6 individuals) and hybrid offspring (80 individuals) arising from the cross between *H. lactucella* (seed parent) and *H. aurantiacum*. Although CHRISTOFF (1942) assumed an autogamous origin for those *lactucella*-like plants occurring among the F_1 progeny, he did not out perform any additional experiments to study the influence of foreign pollen on autogamous events in *H. lactucella*.

GADELLA (1987) was aware that self-incompatibility mechanisms may break down, especially when both the self and foreign pollen are present simultaneously on the stigma (so called "mentor effects" – RICHARDS 1997: 223). At that time, this phenomenon was known e.g. in *Galium* (FAGERLIND 1937, KLIPHUIS 1970). Breakdown of incompatibility of self pollen may occur in plants with either gametophytic or sporophytic self-incompatibility systems. It is probably caused by some diffusible substance produced by foreign pollen (RICHARDS 1997: 223). To check the possibility of such autogamous events in experimental crosses, GADELLA (1987) crossed two sexual species, namely tetraploid *H. pilosella* (as a seed parent without prior emasculation) and diploid *H. peleterianum*. However, no matroclinal tetraploid plants were found among the progeny. On this basis, other sexual types of the subgen. *Pilosella* have also been considered to be self-incompatible.

We undertook a series of crosses between different species occurring in the Krkonoše Mts. (Czech Republic). The plants used in experiments were grown and cross-pollinated in the lowland experimental garden under field conditions. In most of the crosses sexual species (namely diploid *H. lactucella* and tetraploid *H. pilosella*) were used as seed parents. Their

Table 1. Progeny of crosses of sexual diploid *H. lactucella* (species symbol LA) as a seed parent. Figures at the species symbols refer to the clone number of respective species in the collection. There is no correlation between the number of cultivated F_1 plants and the number of germinating well developed seeds (only limited number of F_1 progeny was cultivated due to limited space in the garden).

Pollen parent (ploidy level, species symbol)	Parental pairs (symbols of individuals)	No. of capitula crossed	Total number of well-developed seeds	No. of F_1 plants cultivated	No. of diploid matroclinal plants
H. pilosella (4x, PI)	40LA x 69PI	2	47	11	1
	42LA x 74PI	1	22	9	0
H. glomeratum (5x, GL)	47LA x 48GL	3	88	10	0
	42LA x 25GL	1	10	6	1
	40LA x 10GL	1	6	4	1
	43LA x 51GL	1	81	13	0
	47LA x 51GL	1	38	5	1
	43LA x 10GL	2	7	2	0
	40LA x 25GL	2	27	12	2
H. caespitosum (4x, CE)	44LA x 113CE	1	34	13	0
	45LA x 113CE	1	36	4	0
	43LA x 113CE	1	10	2	0
	47LA x 113CE	1	45	14	2
H. aurantiacum (4x, AU)	43LA x 114AU	1	45	8	0
	44 LA x 114AU	1	35	9	0
	47LA x 114AU	1	46	6	0
				Total 128	8(6.2%)

Table 2. Test on autogamy and apomixis in *H. lactucella* (species symbol LA, for further explanations see Tab. 1) when the effect of foreign pollen was excluded: (A) Individuals used as seed parents in crosses where diploid matroclinal plants occurred in progeny; (B) Other individuals of the same species and ploidy level, originating from the same locality as (A).

Plants used in crosses (A)				Other plants (B)		
Individuals	No. of isolated capitula	No. of emasculated and isolated capitula	No. of non-aborted seeds	Individuals	No. of isolated capitula	No. of non-aborted seeds
40 LA	3	4	0	38 LA	3	0
42 LA	2	3	0	39 LA	3	0
47 LA	1	6	0	43 LA	1	0
				44 LA	3	0
				46 LA	3	0

assumed self-incompatibility, as reported in the literature (see above) should undoubtedly assist experimental work, for no emasculation would be needed. The pairs of parental species involved in crosses were clearly distinguishable by morphology. In addition, all crosses (except for one) were made between species with different ploidy levels. This meant that hybrid progeny could be readily detected by their morphological and karyological characters. Both pollen donor and seed parent capitula were isolated before the crossing. Most of plants in the F_1 progeny were true hybrids. Nevertheless, some matroclinal plants, corresponding to the seed parent both in their morphology and chromosome number were found among progeny of several crosses (Tabs. 1 and 3). However, neither autogamous nor apomictic events were

Table 3. Progeny of crosses of sexual tetraploid *H. pilosella* (species symbol PI, for further explanations see Tab. 1) as a seed parent. All germinating well-developed seeds were kept for cultivation, but a part of seedlings perished before maturity.

Pollen parent (ploidy level, species symbol)	Parental pairs (symbols of individuals)	No. of capitula crossed	Total number of well-developed seeds	No. of F_1 plants cultivated	No. of tetraploid matroclinal plants
H. lactucella (2x, LA)	72PI x 44LA	1	17	2	0
H. glomeratum (5x, GL)	74PI x 10GL	1	2	2	1
	74PI x 48GL	1	4	4	0
	72PI x 51GL	1	6	4	1
	72PI x 48GL	1	2	2	1
H. aurantiacum (4x, AU)	73PI x 119AU	1	53	8	0
				Total 22	3 (13.6%)

Table 4. Test on autogamy and apomixis in *H. pilosella* (species symbol PI, for further explanations see Tab. 1) when the effect of foreign pollen was excluded: (A) Individuals used as seed parents in crosses where tetraploid matroclinal plants occurred in progeny; (B) Other individual of the same species and ploidy level, originating from the same locality as (A). Only empty, aborted seeds were found in isolated as well as in emasculated and isolated capitula of all plants examined.

Plants used in crosses (A)				Other plants (B)			
Individuals	No. of isolated capitula	No. of emasculated and isolated capitula	No. of non-aborted seeds	Individuals	No. of isolated capitula	No. of emasculated and isolated capitula	No. of non-aborted seeds
72 PI	8	2	0	69 PI	13	4	0
74 PI	14	4	0				

recorded in either sexual species when no foreign pollen was present (Tabs. 2 and 4). This is strong evidence for the matroclinal plants obtained in the F_1 progeny of these crosses having originated from autogamous events, which could be due to the presence of both self and foreign pollen on the stigma. In this way, the self-incompatibility may be broken down (see above the "mentor effects" – RICHARDS 1997).

The frequency of offspring of autogamous origin from all crosses together was 6.2% and 13.6% for *H. lactucella* and *H. pilosella*, respectively (Tabs. 1 and 3). If we consider only those crosses in which matroclinal plants occurred in the progeny, the calculated frequency of autogamous events will be even higher (7.6% for *H. lactucella* and 25% for *H. pilosella*). No matroclinal progeny arose from crosses where *H. aurantiacum* was used as pollen parent. We did not succeed in reproduction of Christoff's results for *H. lactucella* × *H. aurantiacum* (CHRISTOFF 1942), although we obtained the matroclinal progeny for crosses between other species. Thus appears that different species (or individuals within the same species) used as pollen donors may differ in their ability to break down self-incompatibility in the seed parent. This phenomenon may therefore depend on particular combinations of parental species and/or individuals. The environmental conditions under which the crosses are carried out may also influence the self-incompatibility mechanism. All these factors should be taken into consideration when discussing the lack of matroclinal progeny in the extensive series of Gadella's experimental crosses (e.g. GADELLA 1987, 1992).

Our experiments have shown that at least two sexual representatives of the subgen. *Pilosella*, i.e. diploid *H. lactucella* and tetraploid *H. pilosella*, may be self-compatible under conditions of hybrid cross-pollination. Mother-like plants of autogamous origin were found among the progeny of both sexuals examined (Tabs. 1 and 3), while there was no evidence of apomixis (Tabs. 2 and 4). The importance of autogamous seed reproduction in subgen. *Pilosella* in nature remains unclear. Nothing is known, for example, about the ecological success of autogamous vs. outcrossed progeny in the field populations.

Acknowledgements: This study was supported by the Grant Agency of the Academy of Sciences of the Czech Republic (project no. A 6005803). Three reviewers are acknowledged for valuable comments and Hazel Chapman for language corrections.

REFERENCES

CHRISTOFF M. (1942): Die genetische Grundlage der apomiktischen Fortpflanzung bei *Hieracium aurantiacum* L. *Z. Indukt. Abstammungs-Vererbungsl.* 80: 103–125.

FAGERLIND F. (1937): Embryologische, zytologische und bestäubungsexperimentelle Studien in der familie *Rubiaceae* nebst Bemerkungen über einige Polyploiditätsprobleme. *Acta Horti Berg.* 11: 195–470.

GADELLA TH.W.J. (1984): Cytology and the mode of reproduction of some taxa of *Hieracium* subgenus *Pilosella*. *Proc. Kon. Ned. Acad. Wetensch. C* 87: 387–399.

GADELLA TH.W.J. (1987): Sexual tetraploid and apomictic pentaploid populations of *Hieracium pilosella* (*Compositae*). *Pl. Syst. Evol.* 157: 219–246.

GADELLA TH.W.J. (1992): Notes on some triple and inter-sectional hybrids in *Hieracium* L. subgenus *Pilosella* (HILL) S.F. GRAY. *Proc. Kon. Ned. Akad. Wetensch.* 95: 51–63.

KLIPHUIS E. (1970): Cytotaxonomic notes on some *Galium* species: *Galium sylvaticum* L., *Galium aristatum* L. and *Galium schultesii* VEST. *Proc. Kon. Ned. Akad. Wetensch. C* 73: 271–283.

RICHARDS A.J. (1997): *Plant breeding systems.* Ed. 2. Chapman & Hall, London.

Received 12 August 1999, revision received and accepted 14 September 1999