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CYTOGEOGRAPHY OF TARAXACUM SECTIO TARAXACUM AND SECTIO ALPESTRIA IN FRANCE AND ADJACENT PARTS OF ITALY AND SWITZERLAND, INCLUDING SOME TAXONOMIC REMARKS

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SUMMARY

In France and adjacent parts of Italy and Switzerland the distribution of diploid and triploid specimens of *Taraxacum* (mainly) sect. *Taraxacum* has been established on the basis of about 200 population samples and of herbarium specimens (c. 5,500 individuals in all). Most diagnoses are based on pollen characteristics, a minority on chromosome counts. Triploids are common throughout France. Diploids occur in the major part of the area with a relative frequency per population of 3 to 100%; they become more common southward from Le Mans-Tours-Strasbourg. Some data from the northern region suggest that there may be a broad transitional zone (towards total absence of diploids), reaching to Middle-Belgium and the Dutch South-Limburg area. To the south diploids are present in the Pyrenees and elsewhere in northern Spain, and in the Alps of Northern Italy. There are but weak indications pointing at some overall ecological differentiation between the di- and triploid cytodemes.

The presence of numerous diploid, sexual species came to light of which 26 belong to sect. *Taraxacum* and 2 to sect. *Alpestria.* Some of the species occur at both the ploidy levels. One may expect that more microspecies may prove to be diploid. In the discussion attention is paid to (1) some of the evolutionary mechanisms thought to be active in the sections studied (facultative sexuality, re-diploidisation) and (2) the consequences of the present data in respect of the applicability of the microtaxonomy within the range of the distribution of the sexual diploids.

1. INTRODUCTION

The present contribution is a continuation of the cytogeographical inquiries carried out in Central and southern Germany and the Alpine region (compare DEN NIJS & STERK 1980; JENNISKENS et al. 1983). The first reference includes a survey of the data pertaining to the incidence in Europe of diploid sexual and triploid agamospermous forms especially of the section *Taraxacum.* The principal cytogeographic conclusions of these investigations are (1) the more or less frequent occurrence of diploid individuals of the sect. *Taraxacum* in large parts of the Alpine region and in S. and C. Germany as far as the Odenwald and also in the northern and eastern parts of Austria; and (2) the greater rarity of diploids in the Alpine Tauern area and in a North-South running zone between Nürnberg and München, see JENNISKENS et al. (1983).

Still farther to the north than the Odenwald diploids were recently encountered in the southernmost part of The Netherlands in the province of Limburg (STERK et al. 1982).

According to DOLL (1982) the diploids of the sect. *Taraxacum* are most probably not original archediploids and relatively primitive but more probably of secondary origin in an evolutionary sense; the di- and triploids are more or less equally advanced and can hardly be distinguished without chromosome counts.

As pointed out in an earlier paper (DEN NIJS & STERK 1980) the possible consequences of the incidence of sexuality are considerable from a taxonomical and biological point of view. Summarised, the following points are essential:

- The applicability of the micro-species taxonomy in the "diploid" regions is questionable. This is due to the almost obligate outbreeding sexuality of the diploids. The microspecies concept is in fact for a great deal based on the genetical isolation of the asexual reproducing triploids (as clones).
- Due to the presence of facultative sexuality in some triploids a (two-directional) genetical connection with the diploids may occur (JENNISKENS et al. 1983). One may hypothesize the incidence of rediploidization in diploid – triploid cycles (compare also DE WET 1971, 1980).
- The co-existence of the sexual and the asexual reproductive system in the populations mixed up of di- and triploids makes investigations necessary to what extend these both reproductive systems interfere (or compete) in the development and/or the maintenance of the populations.

The cytogeographic pattern as far as established so far, shows a disjunction in the geographical range of the diploids in the region of central Bavaria and the Tauern. JENNISKENS et al. (1983) suggest that in Central and Southern Europe there is a bifocal distribution pattern of the diploids, *viz.*, an eastern part-area, for the time being only recorded from N. and E. Austria and the adjoining part of Slovakia, and a western one with high concentrations of diploids in S. W. Germany and Switzerland. The principal goal of the present study was to find out how extensive this western area is, especially in France, so that the accumulated data can be viewed in a wider phytogeographical perspective. To this end we had at our disposal, apart form our population samples collected in the field, a collection of herbarium specimens named by specialists which opened up the possibility of a discrete taxonomic evaluation in the light of karyological data.

2. MATERIALS

2.1. Field operations

In the main flowering season of the successive years 1979 to 1981 a collection of some 150 population samples was gathered from the greater part of France (Series THM, TGT, TRL, TCH, TS 1-10). Only relatively scattered sampling took place in the following regions: the South-West (Bordeaux-Toulouse), the Western part of Brittany, and the extreme North and North-West. A small series of samples was obtained from Val d'Aosta in N.W. Italy (TS 11–17). The samples consisted of from 30 to 40 still incompletely opened capitula kept in 70%

ethanol for laboratory analyses. The samples were mainly taken from meadowland with a varied intensity of uses and managements. A few were collected in much disturbed habitats such as roadsides and -banks (see also *table 1*). From a number of locations live plants were taken away for chromosome counts and for cultivation and hybridisation experiments.

For all above-mentioned series of population samples holds that they have been collected during field excursions by car. In this way it was possible to visit in a short period of time quite a part of the country. The sample meadows are as a matter of fact not randomly situated but systematic, i.e. along the travelling (often minor) roads (routes dèpartementaux).

Fig. 7 is based, apart from the above-mentioned samples, also on a series of observations of smaller samples (about 50 in all) each consisting of at most 10 capitula per site, which are shown as small symbols in the figure: open circles indicate polyploids which are most likely triploids, dots indicate the presence of diploids (irrespective of their relative local frequency) in the sampled population. This series of smaller samples is largely based on field observations made during our longer collecting trips: at more or less set distances between the normal sample sites the size vaiation of the pollen of a small number of flower heads (up to 10) was analysed in the field. In this way, with only a little more effort, a denser meshwork of data was obtained. In addition, a few smaller samples were kindly provided by other botanists.

2.2. Herbarium material

We had the following collections at our disposal:

A. Of the Herbarium-Van Soest (incorporated in L.) about 200 sheets collected in nearly 70 localities scattered through France. A small number (13) of these had been identified partly by Dr. Van Soest himself and partly by Dr. Sahlin; this collection contains (1) material collected by Dr. Billy (Clermont-Ferrand) consisting of 9 populations samples (series TB in *table 1*) and (2) material collected by Dr. De Bray, Brussels: the series TDB, about 60 origins each comprising 1 or 2 specimens.

B. From the Nationale Plantentuin, Brussels-Meise (BR), 138 sheets collected in Val de Bagne (Valais, Switzerland) and named by Drs. Lawalrée and Sahlin; this collection comprises 50 (micro-) species of 6 sections and contains a number of type specimens (see SAHLIN 1982).

The analyses of these herbarium collections are given in Chapter 4.3.

3. METHODS

The samples were collected by traversing each population along imaginary lines at set distances and taking an individual or capitulum at set intervals along these lines. The ploidy levels were determined on the basis of the pollen diameter as was done in previous studies (see e.g. TSCHERMAK-WOESS 1949, DEN NIJS et al. 1980, JENNISKENS et al. 1983). As a rule with this methods diploid individuals

Table 1: Survey of the greater population samples and principal analytical results. Asterisks indicate samples from which chromosome counts have been made.

Sample number	Locality in France	Dept.[1] no.	Height m.a.s.l.	Habitat	No. of plants	Pollen diagnosis ploidy-level (%)			Pollen sterility > 10% (2x only)
						2x	3x	?	
THM 1	Neuilly	02	150	heavily manured pasture	29	–	100	–	–
THM 2	Sézanne	51	–	runderal pasture	32	–	100	–	–
THM 3	Bouilly	10	150	orchard meadow	33	–	100	–	–
THM 4	Auxerre	89	150	little manured woodland pasture	33	–	100	–	–
THM 5	Avallon	89	300	little manured pasture	33	85	15	–	–
THM 6	Saulieu	21	510	short mowed lawn	33	24	76	–	–
THM 7	Lucenay-L'Evèque	71	390	road-side	33	12	88	–	–
THM 8	Colonge	71	370	abandoned grassland	31	6	94	–	–
THM 9	Montcenis	71	350	pasture on heavy clay	33	9	85	6	–
THM 10	Mont-St. Vincent	71	250	little manured pasture, many herbs	33	88	6	6	–
THM 11	Cluny	71	300	orchard-meadow	33	70	30	–	–
THM 12	Villié	69	200	vineyard, road-side	33	6	94	–	–
THM 13	Belleville	69	–	heavily grazed, loam	33	45	55	–	–
THM 14	St. Genis-Laval	69	–	runderal ground	23	–	100	–	–
THM 15	Annonay	07	400	abandoned pasture	33	76	24	–	4
THM 16	St.-Jeure-d'Ay	07	500	little grazed plot, loam	33	97	3	–	9
THM 17	Luc-en-Diois	26	650	sheep-grazed, poor in herbs	33	–	100	–	–
THM 18	Apres	05	750	orchard-meadow	33	–	100	–	–
THM 19	La Bâtie-neuve	05	800	meadow, little manured	33	–	100	–	–
THM 20	Rourebeau	05	540	meadow, heavily manured	33	–	100	–	–
THM 21	Sisteron	04	480	grassy bank	33	–	100	–	–
THM 22	La Javie	04	780	abandoned hay-field	32	–	100	–	–
THM 23	Riez	04	500	alfalfa-field, margins	33	–	100	–	–
THM 24	Reillanne	04	420	moist grassland	34	–	100	–	–
THM 25	La Réglisserie	30	70	sheep-grazed vineyard margin	30	–	100	–	–
THM 26*	St. Jean-du-Gard	30	190	pasture, little grazed	24	92	8	–	–
THM 27	Aulas	30	400	orchard meadow	34	76	24	–	8
THM 28	Le Vigan	30	370	mown and trodden public lawn	23	64	36	–	–
THM 29	Col de la Banière	12	800	meadow	33	46	54	–	–

THM 30	Millac, la Cavalerie	12	570	meadow with alfalfa	33	97	3	–	–
THM 31	Lacaune	81	950	meadow, open stand	33	3	97	–	–
THM 32*	Alban	81	660	alfalfa-field, open stand	33	82	18	–	–
THM 33	Campagnac	81	380	ruderal grassland	33	–	100	–	–
THM 34	Caussade	82	250	ploughed hay-field	33	39	61	–	–
THM 35	Villefranche-de-Rouergue	12	500	infrequently mown hay-field	33	58	42	–	–
THM 36	Lannéjouls	12	500	heavily manured pasture	34	72	28	–	12
THM 37	Les Estresses	15	400	meadow, very rich in herbs	33	100	–	–	3
THM 38	Rouziers	15	530	country-lane, -sides	25	90	10	–	12
THM 39	St. Martin-Valmeroux	15	780	rich pasture	33	100	–	–	6
THM 40	Neuvic	19	–	rich pasture	33	100	–	–	–
THM 41*	Bugéat	19	880	heavily manured hay-field	1	–	–	–	–
THM42	Eymoutiers	86	480	rich pasture	33	82	18	–	5
THM 43	St. Léonard-de-Noblat	86	–	rich pasture	33	88	12	–	–
THM 44	Bourganeuf	23	590	rich pasture, cattle-damaged	34	94	6	–	3
THM 45	Chénérailles	23	550	rich pasture, cattle-damaged	33	82	18	–	4
THM 46	Quinssaines	03	400	rich pasture	33	70	30	–	–
THM 47	Bourbon-l'Archamboult	03	300	little manured, sheep-grazed plot	33	97	3	–	3
THM 48	Bourbon-Lancy	71	300	rich pasture, cattle-damaged	33	87	13	–	–
THM 48	*bis* Bourbon-Lancy	71	300	much trodden lawn	8	80	20	–	–
THM 50	Corveissiat	01	350	manured hay-field	33	30	70	–	10
THM 51	Orgelet	39	520	pasture cattle-damaged	33	50	50	–	–
THM 52A	Lons-le-Saunier	39	–	ruderal heavily manured pasture	10	10	90	–	–
THM 52B	Lons-le-Saunier	39	–	sparingly manured neighbouring plot	10	90	10	–	–
THM 53	Champagnolles	39	530	rich, heavily manured hay-field	33	97	3	–	10
THM 54	Pontarlier	25	900	meadow	5	60	20	20	–
THM 55	l'Hospital-de-GB	25	600	rich pasture	33	88	12	–	–
THM 56	Etuz	70	260	rich grassland, crop rotation	33	–	100	–	–
THM 57*	Fresne-St. Mamès	70	250	moist poor *Carex*-rich hay-field	43	2	98	–	–
THM 58	Chattigny	52	350	old pasture, sod locally damaged	33	88	12	–	–
THM 59	Langres	52	420	little grazed, poor plot	33	12	88	–	–
THM 60	Pont-la-ville	52	220	rich pasture, may Tar's, many herbs	33	12	88	–	–
THM 60	*bis* Châteauvillain	52	280	as THM 59	10	40	60	–	–
THM 61	La Villeneuve-aux-Fresnes	52	310	as THM 59	33	–	100	–	–
THM 62	Briancourt	52	320	poor, heavily grazed, sod damaged	32	8	92	–	–
THM 63	Neufchateau	88	300	rich pasture, many Tar's	33	100	–	–	–

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Sample number	Locality in France	Dept.[1] no.	Height m.a.s.l.	Habitat	No. of plants	Pollen diagnosis ploidy-level (%)			Pollen sterility >10% (2x only)
						2x	3x	?	
THM 63	*bis* Contrexéville	88	–	rich pasture	10	100	–	–	–
THM 64	Dombrot-le-sec	88	400	pasture, many Tar's	33	3	97	–	–
THM 65	Luxeuil-les-Bains	70	350	pasture, little manured	33	30	70	–	–
THM 66	Remiremont	88	400	meadow	33	–	100	–	–
THM 67	Urbès	68	480	meadow	10	100	–	–	–
THM 68	Thann	68	410	heavily manured meadow, many Tar's	33	66	34	–	30
THM 69	Lapoutroie	68	360	meadow	33	100	–	–	3
THM 69	*bis* Fraize	88	–	rich pasture	10	70	30	–	–
THM 70	Rambervillers	88	480	meadow	33	–	100	–	–
THM 71	Schirmeck	67	300	meadow	33	3	97	–	–
THM 72	Abreschviller	57	350	meadow	33	–	100	–	–
THM 80	Nanteuil-les-Maux	60	–	pasture	33	–	100	–	–
THM 81	Montereau	77	130	alfalfa-mixed pasture	28	–	100	–	–
THM 82	Chevannes	45	120	little manured pasture	32	–	100	–	–
THM 83*	la Chapelle-sur-Aveyron	45	130	manured brook meadow	32	25	60	15	–
THM 84	St. Amand-en-Puisaye	58	240	manured pasture	33	24	76	–	12,5
THM 85*	Baugy	18	170	horse-grazed pasture	33	39	21	39	7,5
THM 86	St. Christophe-en-Boucherie	36	230	pasture	32	3	91	6	–
THM 87	Thevet-St. Julien	36	200	heavily manured pasture	31	74	13	13	4
THM 88	St. Benoit-du-Sault	36	250	poor pasture	33	–	100	–	–
THM 89	Confolens	87	–	sheep-grazed rich pasture	32	75	19	6	–
THM 90	St. Claud	16	–	poor pasture	33	58	21	21	–
THM 91	Montmoreau	16	130	damp meadow, *vulgaria* A	25	68	12	20	–
				palustria B	7	–	100	–	–
THM 92	Cognac	16	40	ploughed, resawn meadow	6	50	50	–	–
THM 93	Tonnay-Boutonne	17	30	ploughed, resawn meadow	33	97	3	–	–
THM 94	Niort	79	70	pasture	33	36	39	24	–
THM 95*	Ste. Hermine	85	40	pasture	33	100	–	–	18
THM 96	St. Gilles-Croix	85	20	pasture, sod cattle-damaged	19	–	100	–	–

THM 97	Falleron	85	30	pasture	33	6	88	6	–
THM 98	Clisson	44	50	pasture, sod cattle-damaged	33	97	3	–	6
THM 99	Ancenis	44	–	unmanured hay-field, many herbs	13	100	–	–	–
THM 100	Bonnoeuvre	44	40	soccer field	7	86	14	–	–
THM 101	Bain-de-Bretagne	35	100	much-trodden, poor pasture	33	–	100	–	–
THM 102	Rochefort	56	–	pasture	33	–	100	–	–
THM 103	Auray	56	50	pasture	33	–	100	–	–
THM 104*	Neuillac	56	100	orchard meadow	33	–	100	–	–
THM 105	Merdrignac	22	150	moist, poor pasture	33	–	100	–	–
THM 106	Trinténiac	35	–	poor meadow	33	–	100	–	–
THM 107	La Pellerine	53	–	recently resawn *Lolium*-field	33	–	100	–	–
THM 108	Laval	53	100	pasture: *Poa* sspp.	33	–	97	3	–
THM 109	Meslay-du-Maine	53	–	little manured pasture	33	24	73	3	–
THM 110*	La Flèche	72	70	pasture	33	58	39	3	–
THM 111*	Baugé	49	–	pasture (*Anthoxanthum*)	4	100	–	–	–
THM 112	Saumur	49	–	heavily grazed pasture	33	79	15	6	4
THM 113	Thouars	79	100	alfalfa-*Poa trivialis* field	33	39	42	18	15
THM 114	Descartes	37	100	abandoned pasture	33	3	97	–	–
THM 115	Ligeuil	37	70	poor pasture	15	67	33	–	–
THM 116	Villeuch	37	60	moderately manured pasture	33	73	21	6	8
THM 117	Sosnières	41	–	moderately manured pasture	33	–	97	3	–
THM 118*	Cléry-St. André	45	90	pasture	33	24	64	12	–
THM 119	Connainville	28	100	alfalfa-field (crop rotation)	30	–	97	3	–
TB 1	Beaulieu	63	350	not recorded	10	–	100	–	–
TB 6	Chanonat	63	750	not recorded	15	100	–	–	13
TB 9	Manglieu	63	500	not recorded	15	100	–	–	7
TB 14	Teilhède	63	–	not recorded	31	100	–	–	3
TB 17	Beaulieu	63	400	not recorded	15	–	100	–	–
TB 18	Bromont-Lamothe	63	750	not recorded	15	100	–	–	14
TB 21	Orcines	63	900	not recorded	15	100	–	–	13
TB 23	St. Bonnet-d'Allier	63	500	not recorded	15	7	93	–	100
TB 3)	Ste. Marguerite	63	1150	not recorded	6	100	–	–	–
TGT 1	Saillans	26	300	pasture	30	–	100	–	–
TGT 2	Saillans	26	300	clover-field	33	–	100	–	–

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						2x	3x	?	
TGT 3	Blacons	26	350	meadow	33	–	100	–	–
TGT 4	Flaviac	07	–	pasture	30	–	100	–	–
TGT 5	Fresnau	26	–	road-side	30	–	100	–	–
TGT 6	Col du Devès	26	–	–	33	67	21	12	–
TGT 7	Plan-de-Baix	26	–	pasture	30	–	100	–	–
TGT 8	St. Roman	26	–	pasture	33	–	100	–	–
TGT 9	Vercheny	26	–	meadow	32	–	100	–	–
TGT 10	Le Havre	76	sea	road-side	33	–	100	–	–
TGT 11	Le Havre	76	sea	pasture	30	–	100	–	–
TGT 12	Criel-sur-Mer	76	sea	Falaise-coast	33	–	100	–	–
TGT 13	Criel-sur-Mer	76	sea	pasture	33	–	100	–	–
TGT 14	Blangy-sur-Bresle	76	–	clover-field	33	–	100	–	–
TGT 15	Halloy/Lucheux	80	–	pasture	33	15	85	–	–
TGT 17	Sospel	06	700	not recorded	8	12	24	60	–
TRL 1	Godivelle	63	–	little grazed, species rich pasture	30	100	–	–	–
TRL 2	Espinchal-Egliseneuve	63	–	heavily grazed pasture	33	91	9	–	6
TRL 3	Lac Pavin	63	–	ruderal grassland	30	100	–	–	–
TCH 16	Oloron-Ste-Marie	64	–	not recorded	20	–	90	10	–
TCH 17	Peyrehorade	40	–	pasture	18	78	22	–	–
TS 1	Super Lioran	15	1300	road-side	33	3	97	–	–
TS 2	Super Lioran	15	1500	forest-margin	33	15	73	12	–
TS 3	Super Lioran	15	1500	heavily grazed mountain meadow	30	–	82	18	–
TS 4	Col de la Fageole	15	1000	road-side	25	16	80	4	–
TS 5	Lempdes	43	400	meadow camping ground	27	52	30	19	12
TS 6	Col du Lautaret	05	2058	road-side	33	–	100	–	–
TS 7	Villar-d'Arene	05	1650	road-side	33	–	100	–	–

TS 8	La Grave	05	1350	road-bank	33	–	100	–	–
TS 9	Mont-de-Lans	38	1300	road-bank	31	–	100	–	–
TS 10	Les-2-Alpes	38	1650	pasture	30	–	100	–	–
TDB 1/2	Bergerac, Dordogne	–	–		2	100	–	–	–
TDB 3/4	Bergerac, Dorgogne	–	–		2	100	–	–	100
TDB 5/6	Decize, Nièvre	–	–		2	100	–	–	–
	Locality *in Italy*								
TS 11	La Thuile, Aosta	–	1440	road-side	33	18	76	6	14
TS 12	La Thuile, Aosta	–	1700	road-side	29	–	100	–	–
TS 13	Col Pt. St. Bernard, Aosta	–	2000	runderal alpine meadow	33	–	100	–	–
TS 14	Val di Rhèmes, Aosta	–	1500	road-side	34	6	94	–	–
TS 15	Val di Rhèmes, Aosta	–	1725	road-side	33	30	64	6	–
TS 16	Val di Cogne, Aosta	–	1400	road-side	33	6	94	–	–
TS 17	Val di Cogne, Aosta	–	1540	ruderal grassland	32	–	100	–	–

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[1] According to the official magisterial code (see for example the Michelin Maps).

can be distinguished from polyploid ones. As a consequence of the relative abundancy of the triploid level in the section *Taraxacum* one may assume that in most cases a non-diploid, thus polyploid diagnosis stands for a triploid individual. Compare *table 2* and the above mentioned literature. Some additional remarks to this method are to be given:

- Preferably pollen from still closed florets should be examined because there is always a chance that foreign pollen has previously been deposited on open ones and thus becomes included in the assessment. However, it is not always possible to exclude this source of error in herbarium material, so that analyses of such material need not always be reliable, but one may assume that as a result of such a 'pollination pollution' the diploid scores may be a bit low for the reason that the assessments are conservative.
- The data recorded by JENNISKENS et al. (1983) show clearly that regionally a not inconsiderable part of a stand of dandelions may consist of individuals which, although triploid, have a regular ♂ meiosis judging by the low variation of the pollen diameter. Such specimens are placed in *table 1* in the column:?, which means diagnosis uncertain.
- Presumably the flowering periods of plants at the diploid level and those of individuals at the triploid one do not strictly coincide. It follows that the precise moment of a single sampling may have some bearing upon the relative abundance of the ploidy levels in the stand sampled (see also DEN NIJS & STERK 1980).

The last two considerations, also in view of the relatively small sample size (30–35 specimens) render it necessary to accept that the percentages of the ploidy levels per sample, as shown in *table 1,* are indicative rather than absolute. In a selected number of population samples chromosome counts were carried out in the manner described in previous papers of this series (DEN NIJS et al. 1978, DEN NIJS & STERK 1980).

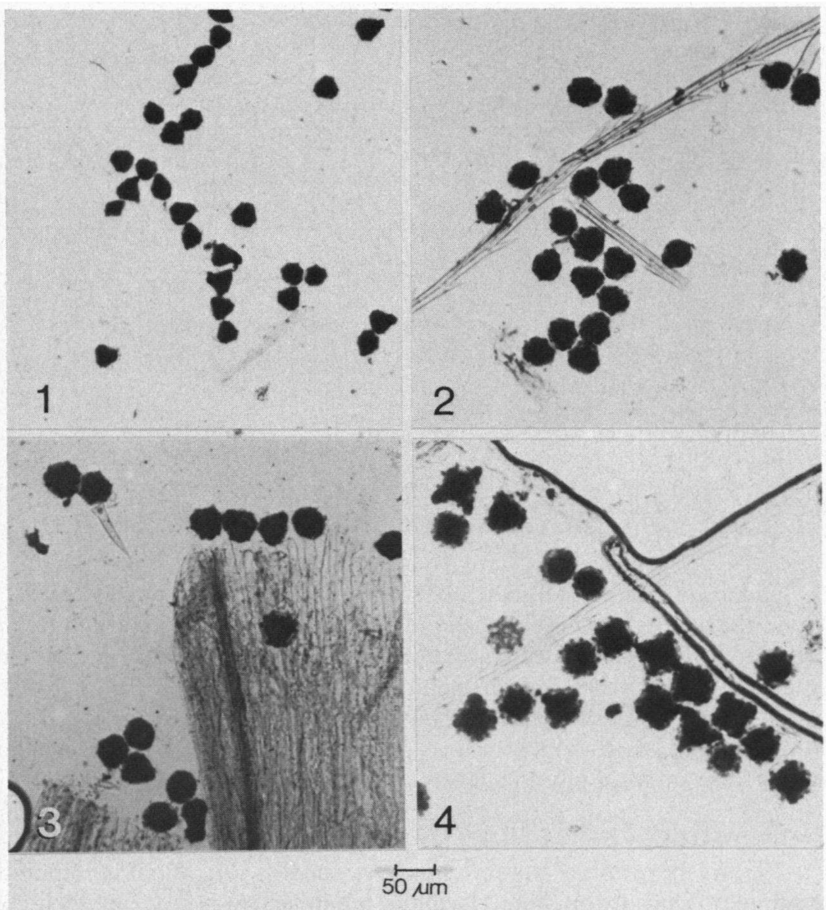
4. RESULTS

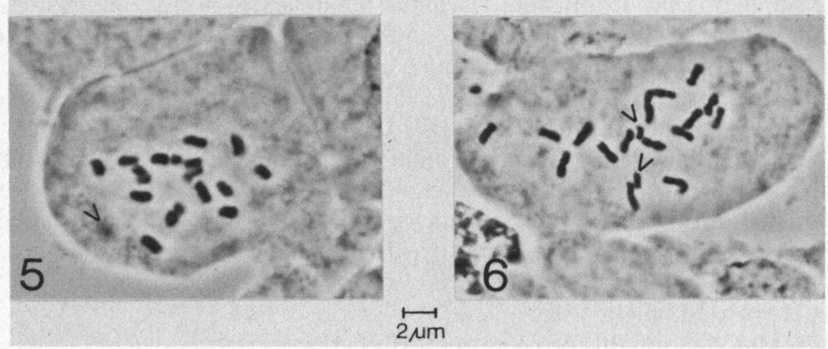
4.1. Generalities

Table 1 gives a survey of the larger samples and of their origin, a concise habitat characterisation, and the results of the pollen size analyses. Those populations in which chromosome counts were carried out are indicated with an asterisk.

In 96 out of the 154 analysed samples diploid, sexual individuals were found. Of these 96 the majority was mixed, diploids and triploids being represented in varying ratios: the 2*x* portion ranges from 3% to 97%. Only 11 samples seemed to be exclusively diploid. Calculated over all samples the proportion of diploids is a little over 50%. The total number of individually studied specimens was over 4,500, which number is about 5,500 when the smaller samples and herbarium sheets are included.

Figs. 1–4 show some examples of pollen preparations on which our diagnoses rest.





Figs. 1–4: Some examples of pollen variability upon which the ploidy diagnoses are based.

1. *Taraxacum aganophytum* v.S.; Verbier, Val de Bagne (CH) 1620 m, BR coll. Lawalrée 22556; Diagnosis: diploid.
2. *T. grypolobum* Sahlin; Verbier, Val de Bagne (CH) 1600 m, BR coll. Lawalrée 23134; Diagnosis: diploid.
3. *T.paramecacrum* Sahlin; Savoleyres- Croix-de-Coeur, Val de Bagne (CH) 2200 m, BR coll. Lawalrée 22690; Diagnosis: diploid.
4. *T. lacistrum* Sahlin; Verbier, Val de Bagne (CH) 1700 m, BR coll. Lawalrée 22534; Diagnosis: triploid.

Figs. 5–6: Examples of chromosome slides:

5. Plant THM 85–1, Baugy, east of Bourges (Dept. Cher): 2n = 16 (15 chr. and a vague dot, representing the 16th., not in focus).
6. Plant THM 95–1, Ste. -Hermine, between La Rochelle and Nantes (Dept. Vendée): 2n = 16, note the very large fragments separated by the secondary constriction (indicated by an arrow).

Table 2: Survey of chromosome counts in 40 plants taken from 11 populations.

Pop. no.	No. of plants studied	Chromosome number diploid	triploid
THM 26	1	2n = 16	
THM 32	4	2n = 16, 16, 16	2n = 24
THM 41	1	2n = 16	
THM 57	4		2n = 24, 24, 24, 24
THM 83	6	2n = 16, 16, 16, 16, 17	2n = 24
THM 85	2	2n = 16, 16	
THM 95	2	2n = 16, 16	
THM 104	2		2n = 24, 24
THM 110	9	2n = 16, 16, 16, 16	2n = 24, 24, 24, 24, 24
THM 111	4	2n = 16, 16, 16, 16	
THM 118	3	2n = 16, 16	2n = 24

Two points of interest in *table 1* are the following:

– Upon the whole the number of dubious cases is very low, *i.e.*, triploids with subregular pollen are relatively rare. Locally they may be of more common occurrence: in the northern part of the area sampled towards the border of the previously determined diploids range (compare also *fig. 7*).

– Male sterility (*i.e.*, the incidence of pollen without cytoplasm is, generally speaking, rare among diploids, but is found scattered throughout the area.

4.2. Chromosome counts

Table 2 shows the results of the chromosome counts as carried out in 11 population samples. The corresponding localities are indicated in *fig. 7* by their code number. No deviating counts were found in respect to the diagnoses based on the pollen grain diameters. *Figs. 5* and *6* are examples of metaphase plates. In a few individuals (such as THM 83 and 95) a certain degree of internal variation of the number was recorded (2n = 17, 18, 15). An odd specimen had 2n = 17. It is not at all unlikely that such an instability and variation is attributable to the pollination of a diploid mother plant with somewhat irregular pollen from a triploid individual (n = 7, 9, 10). Such a variation may be regarded as indicative of gene-flow between the diploid cytodeme and the triploid one.

4.3. Herbarium analyses

4.3.1. Material from France: Van Soest Herbarium (incorporated in L.).

– A group of 9 samples (the TB series), each comprising between 6 and 31 individual specimens, 137 in all, from the Puy-de-Dôme. Of these 9 samples 6 are 100% diploid, one is mixed, and 2 are completely triploid. These data are entered in *fig. 7*.

– A collection of small samples (leg. De Bray, series TBD), about 60 in all, each consisting of one or two individual specimens, from various parts of France. Of these 60, 19 (from the Dordogne, the area surrounding Le Hâvre, and the western Banlieu of Paris) were diploid, and only these 'diploid' locations are included in the records of *fig. 7* (as black dots).

Of these two collections a number of sheets (in herb. Van Soest) was identified to the microspecies level, so that in these cases the ploidy level could be related to the systematic status. In the following enumeration *Lit* (erature) refers to previous counts (*e.g.*, "24") and for the assessment of the ploidy level on the bases of pollen characteristics (*e.g.*, "3x").

Sectio TARAXACUM	DIPLOID
T. achropodum v.S.,	Ste-Marguérite, Puy-de-Dôme, TB 31.1.
T. aeruginiceps Hagl. ex Sahl.,	Chanonat, Puy-de-Dôme, TB 6.1.
T. batracheium v.S.,	Ste-Marguérite, Puy-de-Dôme, TB 31.2.
T. belophorum Sahlin,	Teilhède, Puy-de-Dôme, TB 14.
T. brevifolium,	Ste-Marguérite, Puy-de-Dôme, TB 31.3.
T. domense v.S.,	Chanonat, Puy-de-Dôme, TB 6.2.
T. graminicolor,	Suresnes, Hts-de-Seine, TDB 30.
T. lemniscatum Sahlin,	Ste-Marguérite, Puy-de-Dôme, TB 31.4.
T. pallescens Dt.,	Gonfreville, Seine-Mtme, TDB 37.

Sectio TARAXACUM	both DIPLOID and TRIPLOID
T. aurosulum Lb.f.,	*2x*: St.-Germain-en-Laye, Seine-et-Oise, TDB 45; *3x*: St.-Germain-en-Laye, Seine-et-Oise, TDB 46, 47; Lit.: Sterk et al. 1982: 3x.
T. polyodon Dt.,	*2x*: le Havre, Seine-Mtme, TDB 54; *3x*: Chatou, Seine-et-Oise, TDB 53; le Hâvre, Seine-Mtme, TDB 55, 56, 74; Lit.: RICHARDS & SELL 1976: 21, 22, 23, 24, 44, 45, 46, 47, 48; DOLL 1982: 17, 21, 22, 23, 24, 25, 48; DEN NIJS & STERK 1982: 24.

Sectio TARAXACUM	TRIPLOID
T. ardisodon Dt.	Le Vesinet, Yvelines, TDB 75.
T. pallidissimum v.S.	Chatou, Seine-et-Oise, TDB 48.

4.3.2. Vallée de Bagne, Valais, Switzerland, Herbarium BR.

The material comprises 138 specimens, all from the Vallée de Bagne, and named: there are 50 microspecies in 6 sections, among which the type specimens of 8 species. An appreciable part of the specimens appeared to be diploid judging by the pollen diameters. This collection contains 26 representatives of sect. *Taraxacum* of which 11 are diploid, and 17 of sect. *Alpestria* of which 3 appeared to be diploid, one of these three being represented at the di- and triploid level; another 2 diploid species are of unknown sectional identity. An enumeration of the localities (sometimes several per microspecies) and the results of the pollen diagnoses follows (the sequential herbarium number added between brackets):

DIPLOID
Sectio TARAXACUM

T. aganophytum v.S.,	Verbier, 1620 m (22.556).
T. alatiforme Rail.,	Versegères, 890 m (23.525).

T. cataschistum Sahlin,	Verbier, 1620 m (22.557), 2200 m (22.698), 2100 m (23.200).
T. erntrum v.S.,	Verbier, 1850 m (21.486); Savoleyres-Croix-de-Coeur, 2200–2250 m (22.689, TYPUS).
T. fasciatiforme v.S.,	Croix-de-Coeur-Savoleyres, 2300 m (21675).
T. grypolobum Sahlin,	Verbier, 1550 m (23122, TYPUS), 1600 m (23133, 23134), 1350 m (23494).
T. infucatulum Sahlin,	Verbier, 2100 m (23.196, TYPUS).
T. ligerinum Sahlin,	Verbier, (23.199)
T. peliogoniatum Sahlin,	Verbier, 1620 m (22.558, TYPUS).
T. pulchrifolium Markl.,	Verbier, 1700 m (23.139).
T. olivaceoides v.S.,	Verbier, 2040 m (23.204).

Sectio ALPESTRIA

T. centrotum Sahlin,	Verbier, 1650 m (23.169, TYPUS), 1700 m (23.144), 2200 m (23.188).
T. glandolense v.S.,	Verbier, 1620 m (22.555); Savoleyres, 2350 m (22.684).

Section UNDETERMINED

T. nantuatum Sahlin,	Savoleyres-Croix-de-Coeur, 2200–2250 m (22.685, 22687).
T. paramecacrum Sahlin,	Verbier, 1850 m (21.485); Savoleyres-Croix-de-Coeur, 2200–2250 m (22.690).

both DIPLOID and TRIPLOID

Sectio TARAXACUM

T. brevifloroïdes v.S.,	La Chaux-les-Clerondes, 2200 m (23.225: one specimen 3x, another possibly 2x). Lit.: Richards (1969): 2n = 16.

Sectio ALPESTRIA

T. albulense v.S.,	2x: Savoleyres-Croix-de-Coeur, 2200–2250 m (22.686); 3x: Verbier, 2200 m (23.189).

TRIPLOID and HIGHER LEVELS (when indicated)

Sectio TARAXACUM

T. catameristum Sahlin, Verbier, 2200 m (23.186).	
T. davosense v.S.,	Verbier, 1510 m (22.454).
T. ekmanii Dt.,	Verbier, 1700 m (23.145), 1480 m (23.146). Lit.: Richards & Sell (1976): 2n = 24. Den Nijs & Sterk (1982): 2n = 24.
T. hypopolium Sahlin,	Verbier, 2040 m (23.206, 2 exx.)
T. lacistrum Sahlin,	4x?: Verbier, 1650–1700 m (22.534); 3x: Verbier, 1510 m (22.457, TYPUS); not polliniferous: Verbier, 1510 m (22.457, TYPUS). (Two specimens on one sheet)
T. laiense v.S.,	Mauvoisin, 2050 m (23.318).
T. lasiodasum v.S.,	Mauvoisin, 2000 m (21.775).
T. magnodilatatum v.S.,	not polliniferous: les Clerondes, 1980 m (21.627).
T. oblongatum Dt.,	Verbier, 1350 m (23.505).
T. praterense Sahlin,	Verbier, 2100 m (23.203).
T. subarmatum Hgd., v.S. and Zb.,	Verbier, 1550 m (23.121), 1700 m (23.140, 23.141).

T. subcanillans Sahlin,	les Clerondes, 1980 m (21.624).
T. walo-kochii v.S.,	Mauvoisin, 2050 m (23.315).

Sectio ALPESTRIA

T. fontqueri v.S.,	Verbier, 2150 m (23.220).
T. ochrospermum v.S.,	Boussine, 2050 m (23.303); Verbier 2200 m (23.177); Panossière, 1900 m (21.751).
T. ooststroomii v.S.,	la Rechouen, 2200 m (21.598).
T. pallidisquameum v.S.,	Mauvoisin, 2000 m (21.774).
T. perfissum v.S.,	Verbier, 1510 m (22.453); not polliniferous! Verbier, 1780 m (23.216).
T. rhaeticum v.S.,	not polliniferous: Bonatchesse, 1570 m (23.421). Lit.: Richards & Sell (1976): 2n = 24.
T. rufocarpoides v.S.,	Verbier, 2200 m (23.180).
T. simpliciusculum v.S.,	Boussine, 2050 m (23.302).
T. strictolobum v.S.,	Boussine, 2050 m (23.312).
T. stylosum v.S.,	Verbier, 1650–1700 m (22.538).
T. vereinense v.S.,	Verbier, 2040 m (23.209), 2200 m (23.185), 4x?: Verbier, 2200 m (23.182).

Section UNDETERMINED

T. thysanodes Sahlin,	Verbier, 2040 m (23.205).

Sectio ALPINA

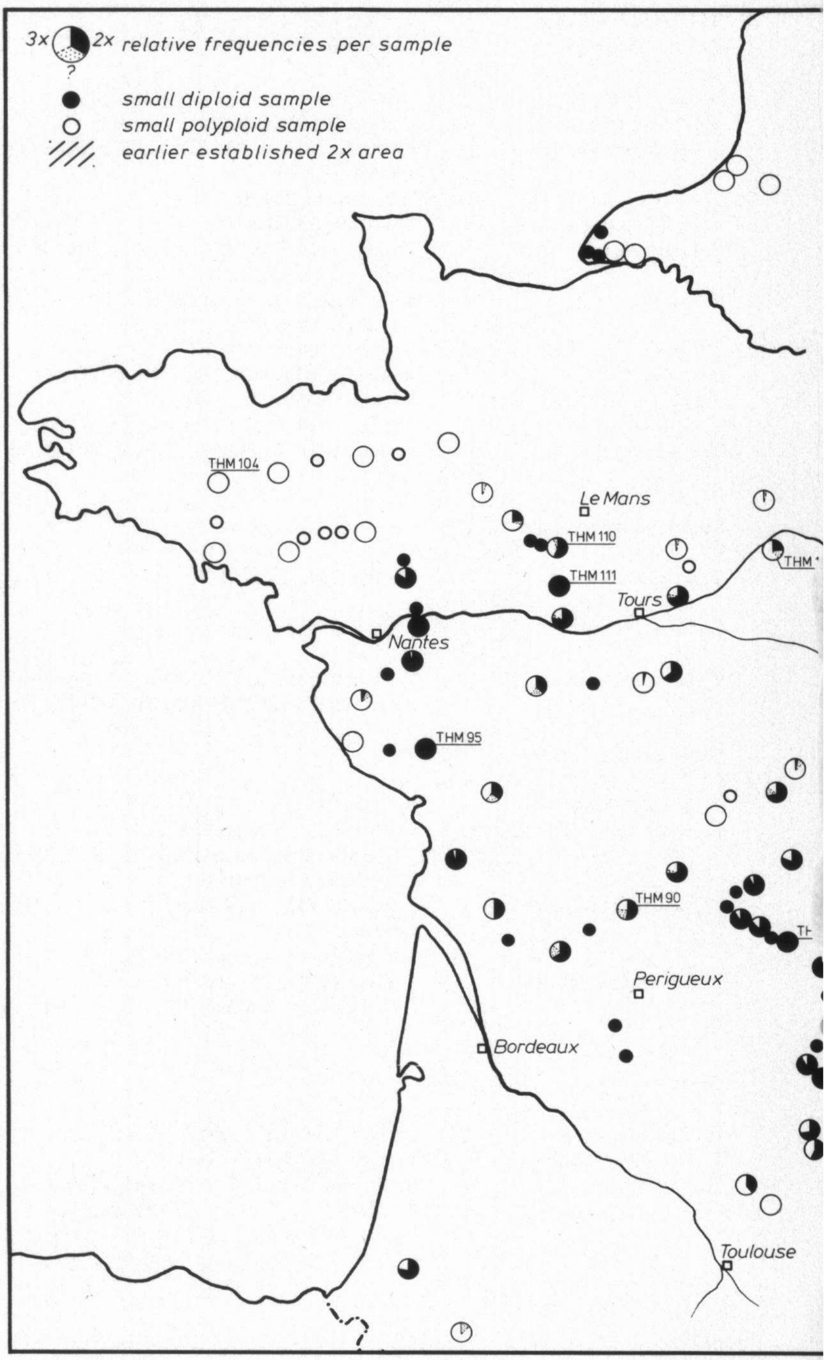
T. panalpinum v.S.,	Verbier, 2200 m (23.178, 23.181); Boussine 2050 m (23.307); Mauvoisin, 2000 m (21.771). Lit.: Doll (1982): 2n = 32.

Sectio ERYTHROSPERMA

T. aequabile Hagl.	Boussine, 2050 m (23.314).
T. lacistophyllum (Dt.) Raunk.,	les Clerondes, 1980 m (21.620). Lit.: Richards & Sell (1976): 2n: 24, 25; Doll (1982): 2n ≐ 24, 25, 32; Den Nijs & Sterk (1982): 2n = 24.
T. purpureomarginatum v.S.,	Savoleyres-Croix-de Coeur, 2200–2250 m (22.691); Les Verneys, 1100 m (22.531). Lit.: Richards & Sell (1976): 2n = 24; Doll (1982): 2n = 32.
T. rubicundum (Dt.) Dt.,	Verbier, 1970 m (21.489). Lit.: Richards & Sell (1976): 2n = 24; Doll (1982): 2n = 24, 25, 48.

Sectio FONTANA

T. aurantellum v.S.,	Verbier, 1510 m (22.455).
T. binilobatum Sahlin,	Verbier, 141500 m (23.153).
T. pohlii v.S.,	Mauvoisin, 200 m (21.778); not polliniferous: Verbier, 2200 m (23.184). Lit.: Richards & Sell (1976): 2n = 32.


3x
2x
?
relative frequencies per sample
small diploid sample
small polyploid sample
earlier established 2x area
THM 104
Le Mans
THM 110
THM 111
THM
Tours
Nantes
THM 95
THM 90
TH
Perigueux
Bordeaux
Toulouse

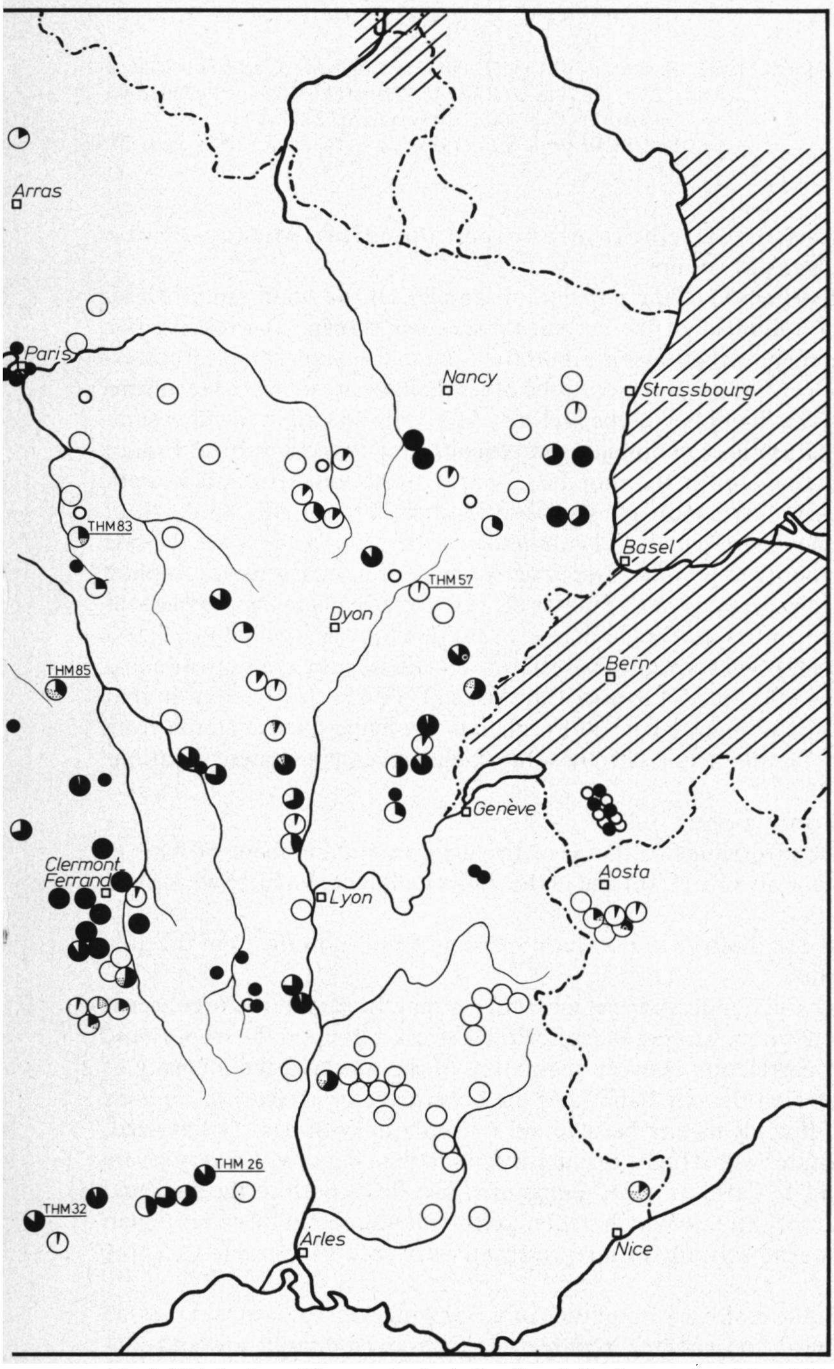


Fig. 7: Distribution of the samples, including the relative frequencies of the ploidy levels. The small symbols (open or black) represent the smaller samples (mainly herbarium material). Populations from which chromosomes are counted, are indicated with their code number. The polyploids as indicated by an open symbol (parts) are most likely triploids.

Sectio RHODOCARPA

T. schroeterianum Hand.-Mazz.,	Boussine, 2050 m (23.301); la Chaux-les Clerondes, 2200 m (22.701, 22.702); les Ruinette, 2200 m (23.560); not polliniferous: la Chaux-les Clerondes, 2200 m (22.703,23.221). Lit.: RICHARDS & SELL (1976): 2n = 24; DOLL (1982): 2n = 24, 32.

4.4. Geographical distribution and ecological amplitude of the diploid, sexual forms.

In *fig. 7* the distribution of the population samples, of the small samples and, in addition, of a number of the herbarium sheets is shown. The relative size of the black segment in the larger symbols (relating to the larger samples) corresponds with the percentage of diploids; the other diploids are indicated by means of black dots. The diploid cytotype is clearly very wide-spread in the area sampled: varying percentages of diploids were encountered in most parts of France visited. Exceptions are for the time being parts of the northern and western regions (Brittany, Normandy, etc.) and a part of the French Alps to the S. of Grenoble. Diploids are particularly common in the area to the S. of the line Le Mans-Strasbourg to become rarer towards the N. A more intensive sampling may show that the percentage of diploids decreases gradually in the populations as we found earlier in Central Germany (Frankfurt-Stuttgart), compare JENNISKENS et al. (1983). The most north-westernly localities in the area surrounding le Hâvre (series TDB, see § 4.3) and near Arras (TGT 15) clearly point in that direction, but up to now we have not procured any living plant material from these areas, so that no actual chromosome counts of such advanced locations are available.

Some noteworthy points:

- The presence of diploids to the S. of the main mountain chain of Alps in the Val d'Aosta, Italy (TS 11/16) and in the Vallée de Bagne, Valais, Switzerland (herb. BR).
- The incidence of diploids in northern Spain (not shown in *fig. 7*) in the area of Picos d'Europa.

The concise habitat indications in *table 1* show that the samples were collected in grassland lots with a varying rate of cultural stress, but upon the whole there is no manifest correlation between the nature of the sites and the intensity of the management on the one hand, and the occurrence or absence of diploids on the other, diploids having been found not only in both heavily fertilized, productive pastures with a high grazing stress and urban parks with a very severe mowing regime, but also in poor, unmanured hay fields both in the Jura and the Vosges and the extreme W (Charente, Loire-Atlantique). In the latter region they may grow sympatrically with representatives of sect. *Palustria* (*e.g.*, THM 91).

The width of the ecological amplitude of the diploid cytotype is alos expressed in a climatological comparison, because it occurs from eu-atlantic lowland conditions in the extreme W to alpine situations in the (high) montane zones (Massif

Central: up to 1500 m; Val de Bagne: till over 2000 m alt.!).

The geological and edaphic conditions also cover a wide range: granites, eruptive rocks, cretaceous rocks, Tertiary and alluvial deposits, heavy loams and clays but also sandy substrates and stony soils.

More or less in contrast to the broad amplitude, a comparison between the samples THM 52A and 52B indicates that the stands of dandelions in two adjacent fields may contain a widely different percentage of diploid individuals, a much higher rate of disturbance apparently being detrimental to the diploid forms. This shows that a comparative inquiry into the ecology of the di- and the triploid cytotypes was indicated. Such a study, both by means of observations in the field and experimentally, is being undertaken.

5. DISCUSSION

5.1. The cytogeographical aspects

Owing to the procedure followed during the sampling the recorded percentual distributions of di- and of triploids in a population or stand can only have an indicative rather than an absolute value. The differences in pastural ecology, the relatively small sample size, and the one-time gathering are the uncertain

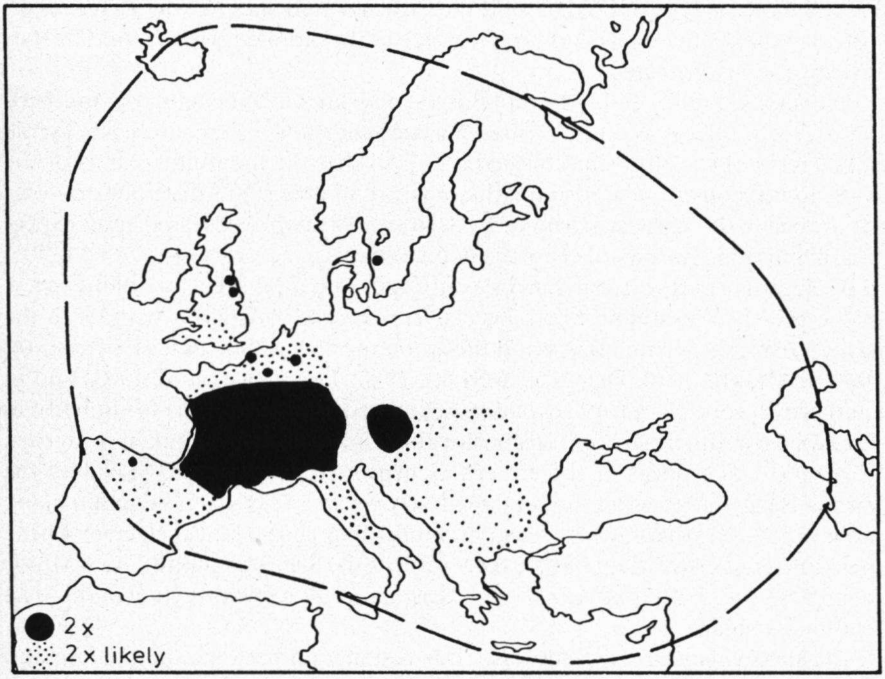


Fig. 8: Map showing the original (indigenous) part of the distribution area of the section *Taraxacum* (after DOLL 1982). The "diploid" areas and, as far as known, isolated locations are indicated. According to the present authors diploids may well be present in the dotted regions.

factors involved, as pointed out before (DEN NIJS & STERK 1980).

In contrast to the situation in Bavaria (JENNISKENS et al. 1983), in the present study only a few triploid specimens were found in the category of doubtful cases (pollen type PT as in STERK et al. 1982). The diagnoses based on the examination of pollen alone were consistently confirmed by subsequent chromosome counts. The quick routine method once more proved to be convenient and useful.

When the hitherto recorded distribution of sexual and diploid forms of sect. *Taraxacum* in the G.F.R. and the Alpine region (FÜRNKRANZ 1966, DEN NIJS & STERK 1980, JENNISKENS et al. 1983) and in the most southern part of the Netherlands (STERK et al. 1982) is related to the present survey in France, the following deductions come to mind (compare also *fig. 8*):

In a considerable part of the geographical range of sect. *Taraxacum* (as indicated by DOLL 1982) secondary diploid (and sexual) forms are found. The present data suggest the incidence of diploids outside the area sampled by us in northern France and in Belgium, thus linking up with the Dutch localities and the adjacent area of Germany. (DEN NIJS, in prep.). The very scattered occurrence of diploids in county Durham (England), see RICHARDS (1968), may indicate that in at least SW England also diploids may be expected to occur.

The range of sect. *Taraxacum* also extends into the Iberian Peninsula, Italy and the Balkans. From Spain no other records are known apart from that from Picos d'Europa. The diploids found there clearly indicate that the Pyrenees do not form the southwestern limit of the range of the diploid forms, so that further investigation is indicated.

The same holds for Italy: the diploids are now known to occur in the southern Alps (Aosta region and also Valais, Switzerland) and in the southern Tyrole near Trento (DEN NIJS, unpublished data), so that the mountain chains of the Alps do not constitute a barrier either against a farther N-S distribution – this in contrast to the supposition made by SAHLIN (1982) who expressed as his expectation that diploids did not cross the Alpine chains.

As regards south-eastern Europe, only sporadic data are available. In view of the presence of diploid taxa of sects. *Taraxacum* and *Erythrosperma* in the eastern Alps, the Vienna Basin and the adjoining part of Slovakia (FÜRNKRANZ 1966; RICHARDS 1970; DEN NIJS & STERK 1980; JENNISKENS et al. 1983) and in southern Europe (DOLL 1972) one may anticipate the incidence of diploidy in *Taraxacum* in other parts of Czechoslovakia and the Balkans (and in S. Europe in general). The floras of the eastern escarpement of the Alps, Slovakia, the Vienna Basin and the surrounding, relatively warm and dry areas contain many more or less xerothermic taxa as a pannonic phytogeographical element whose main centre of distribution lies farther towards the S-E Balkans and Asia Minor (compare, *e.g.*, NIKLFELD 1973; DEN NIJS 1983). A relevant cytogeographical study is intended.

The survey map of *fig. 8* shows a clear disjunction between the Eastern and the Western parts of the range of the diploids (compare also JENNISKENS et al. 1983). There is an extensive western part-range of the diploids of sect. *Taraxacum* proper and a still in size incompletely known eastern one of the pannonic vicariant of this section (ŠAHLIN 1972, 1979). This situation suggests a correlation with the Pleistocene glacials and the associated western and eastern refugia (or centres of migration, respectively).

The incidence of secondarily originated diploid forms is not restricted to sect. *Taraxacum*. In the area so far studied, also diploid *Alpestria* taxa have been encountered, and some diploids with *Palustria* characteristics have also been recorded. Elsewhere in Europe diploid forms of sect. *Erythrosperma* have been found: the eastern Alpine escarpment (see above), Durham (England): *T. brachyglossum* (RICHARDS 1968) and S. Europe (DOLL 1972). In Asia, especially in Japan, diploids are also of wide-spread incidence in the sects. *Ceratophora* and *Mongolica* (MORITA 1976, 1980). Seventeen species from several hundreds of localities are involved. Such findings suggest that rediploidisation has occurred on a large scale in several divergently advanced sections of the genus *Taraxacum* as a parallism. Diploid-polyploid cycles as mechanisms of evolutionary progression have also been noted in other taxa: DE WET (1971, 1980): *Dichanthium* and *Botriochloa;* EHRENDORFER (1963): *Calamagrostis*. STEBBINS (1980), on the other hand, considers this strategy to be of only minor significance. Pertaining experimental investigations in *Taraxacum* are in progress; the preliminary results of these studies render it highly probable that reduced pollen from triploid individuals as obviously formed in various quantities may fertilize haploid egg cells of diploid plants, so that no diploid male parents are required to produce an offspring of isolated diploid plant. Viability being disregarded as a complicating factor, the population density of the diploid forms may thus increase *irrespective* of the number of diploids already present in the population (STERK & DEN NIJS, in prep.).

The biological background of this process, which is most probably demographic-genetically and demographic-ecologically very complex, is as yet still obscure. It may signify that the sexual (and diploid) system of reproduction and the agamospermous (and triploid) one are directly opposed. Both systems have their pros and cons (compare MAYNARD SMITH 1979). Summarizing some of these points: *sexual*: development of new genotypes with adaptational advantages; capability to occupy new niches; risk of loss of individuals by insufficient immediate fitness. *Asexual*: immediate fitness maintained through the absence of recombinations; seed-set independent of pollinations; as a consequence of the small number of genotypes no rapid adaptational changes which cause problems in changing environments. The two modes of reproduction are presumably not in constant confrontation, however, but rather constitute a complementary adaptive system which results from gene flow between the diploid and the triploid levels. It would seem as if in southwestern and Central Europe there is (or was) a shift towards the sexual form of reproduction, apparently by rediploidisation.

For various but mainly practical reasons, in the majority of the samples neither any attention was paid to the morphological variation nor to the taxonomical aspects. The great ecological diversity of the sites where diploids and triploids appear to grow suggests that within the established range of habitats from the sea level to the alpine zone, and in diverse climatological and edaphic situations, a gamut of ecotypes is present. Also in view of the opulence of micro-species in pastures, *e.g.*, in The Netherlands (STERK et al. 1983) and in Austria (FÜRNKRANZ 1966), and of the great morphological divergence in the grasslands under investigation, one may expect that many of these microspecies are diploid or partly so. The collection of named taxa included in the present study provides some insight into the systematic aspects of the present findings.

5.2. Taxonomic aspects

In all, diploid individuals have been recorded in 28 named taxa of which 3 belong to sect. *Alpestria* and 23 to sect. *Taraxacum*. A number of microspecies contain both cytotypes: *T. albulense, T. aurosulum, T. polyodon*, and *T. brevifloroides*. Such taxa are cogent proof of the very close relationship between the cytotypes, in fact so much so that experienced taraxacologists cannot distinguish between them. Either an autoploid origin of the triploids or an auto-rediploidisation must be accepted as the most probable.

The records in VAN SOEST's *Taraxacum* flora of Switzerland (1969), *viz.*, some160 microspecies (in sect. *Taraxacum* and in sect. *Alpestria*) and some recent additions (11 in sect. *Taraxacum* and 2 in sect. *Alpestria*) by SAHLIN (1982) strongly suggest that many more species may prove to be diploid and more taxa may consist of plants of both the 2x and the 3x level. A number of taxa reported now as to be diploid have been said both to produce pollen and to be apolliniferous. Absence of pollen in a dandelion usually means that the plant in question is a triploid one. A number of species is reported in the diagnosis to be apollineferous (SAHLIN 1982), but we did find pollen in the type specimens (!) which pollen moreover, led to a diagnosis as a dipliod. The descriptions of such taxa (here *T. centrotum, T. cataschistum, T. grypolobum, T. infucatulum, T. peliogonatum*) are, therefore, incomplete. If indeed also specimens of these taxa without pollen occur, it follows that these microspecies consist of forms with different ploidy levels.

The diploid taxa have a variety of distribution ranges: some are endemic or have so far only been recorded from a single Swiss canton: *T. aganophytum, T. cataschistum, T. erntrum* and *T. grypolobum*. Other ones are more widespread: *T. albulense, T. brevifloroides* (the Alps), *T. ligerinum* (France, Switzerland, Denmark), *T. olivaceoides* (France, Switzerland), *T. pallescens, T. polyodon* (western and northern Europe).

These records clearly indicate the appreciable involvement of diploidy and associated problems of hybridisation and gene flow in the formal taxonomy of the genus.

Hybridisation experiments carried out within the scope of the present study (Jenniskens, in prepar.) have shown that diploid specimens hailing from the most diverse habitats and from all parts of the area of distribution can be crossed without a genetical barrier and produce viable and fully fertile progenies.

One must accept that the postulated hybrid swarms (DEN NIJS & STERK 1980 and SAHLIN 1982) may occur all over the range of the diploids. The applicability of the current micro-systematics to forms from that area may be queried to a progressive degree. It is highly probable that the section *Taraxacum*, and conceivably (parts of) other sections, are in such a dynamic state of microevolution and speciation that the production of a formal taxonomy is in fact impossible in large parts of the area of distribution (this agrees with views expressed by DOLL 1982).

On the basis of the present data and records we can visualize the following picture: In western Europe an extensive and intricate complex occurs of sexual diploid and agamospermous triploid forms (biotypes) of sect. *Taraxacum*. Between these types gene flow is possible and presumably of frequent occurrence. Taxonomically this complex *as a whole* could better be treated as a large and very intricate species. In the northern direction the agamospermous mode of reproduction progressively becomes dominant ultimately to become exclusively agamospermous, so that genetically isolated microspecies differentiated which became adapted to certain special microhabitats. It is to be expected that in central (and South-Eastern?) Europe a similar situation exists, that also the sections *Erythrosperma* and *Alpestria* are involved in this evolutionary trend, and that also in South-east Asia a similar complicated situation is likely to be present in sections *Ceratophora* and *Mongolica*.

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