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Chromosome numbers of North African phanerogams. I.

Abstract

Vogt, R. & Oberprieler, C.: Chromosome numbers of North African phanerogams. I. — Fl. Medit. 3: 187-210. 1993. — ISSN 1120-4052.

Chromosome numbers are reported for 38 Moroccan Compositae. Seven reported taxa have not previously been investigated cytologically or have chromosome numbers differing from previous reports. Counts for nine additional taxa are the first reports for Morocco or North Africa.

Introduction

This paper is the first of a planned series dealing with cytological investigations in the Moroccan flora. It focuses on the report of chromosome numbers for 38 members of *Compositae*.

Extensive reports of chromosome numbers of North African phanerogams were previously made by Humphries & al. (1978), Talavera & al. (1984) and Molero & Montserrat Martí (1986) as well as Quézel (1957), Favarger & al. (1980) and Galland (1990). The three latter papers concern especially the mountain flora of Morocco. A comprehensive list of taxonomic treatments of particular plant groups containing chromosome numbers of Moroccan plants may be found in Galland (1990).

Material and Methods

The seed material used for this study was collected during two field trips in Morocco organized by the Institute of Systematic Botany, Munich University, in 1987 and 1989. The collection sites are listed below and their approximate position is indicated in Fig. 1.

Locality 1: Prov. de Tetouan; 3 km SW of Ceuta along the road (P 28) to Tetouan, c. 10 m, 5°21' W - 35°52' N, 22.6.1989.

Locality 2: Prov. de Tetouan; 7 km S of Ceuta, along the Road to Tetouan (P 28), c. 10 m, swamp, 5°21' W - 35°50' N, 22.6.1989.

Locality 3: Prov. de Tetouan; 7 km N of Mdiq along the road from Tetouan to Ceuta (P28), moist hollow, 5°21' W - 35°44' N, 22.6.1989.

Locality 4: Prov. de Tetouan; southern shore of Barrage Ajras along the road between Tetouan and Tanger (P 37), cultivated fields, 5°31' W - 35°34' N, 22.6.1989.

Locality 5: Prov. de Tetouan; Larache - Tetouan (P 37), 3 km NE of Darchaoui, meadow, 120 m, 5°43' W - 35°32' N, 5.5.1987.

Locality 6: Prov. de Tetouan; northern shore of Oued Loukos (N of Larache), c. 10 m, dunes c. 2 km inland, 6°08' W - 35°13' N, 23.6.1989.

Locality 7: Prov. de Kenitra; 4 km SW of Lalla-Mimouna along the road between Arbaoua and Moulay-Bousselham (S 216), 6°07' W - 34°51' N, 23.6.1989.

Locality 8: Prov. de Meknes; Moyen Atlas, Souce Vitell NW of Ifrane, 1570 m, 5°07' W - 33°33' N, 28.6.1989.

Locality 9: Prov. de Taza; surroundings of Taffert on the road from Ahermoumou (Ribat-el-Kheyr) to Jebel Bou Iblane (4803), 1680 m, limestone, 4°15' W - 33°40' N, 25.6.1989.

Locality 10: Prov. de Taza; Moyen Atlas, c. 10 km E of Taffert along the road from Ahermoumou (Ribat-el-Kheyr) to Jebel Bou Iblane (4803), 1680m, 4°12' W - 33°39' N, 25.6.1989.

Locality 11: Prov. de Taza; Moyen Atlas, Jebel Bou Iblane, surroundings of the Refuge de Taffert near the road 4803, cedar-forest, 1830-1930 m, 4°10' W - 33°39' N, 25.6.1989.

Locality 12: Prov. de Taza; Moyen Atlas, Jebel Bou Iblane, north faced slopes, road of Tizi Bouzabel, 2 km above the forest station at 2040 m, stony slopes, 4°10' W - 33°39' N, 26.6.1989.

Locality 13: Prov. de Taza; Moyen Atlas, Jebel Bou Iblane, "Bain pour le mouton" on the nothern slopes of Jebel Bou Iblane, c. 2000 m, 25.6.1989.

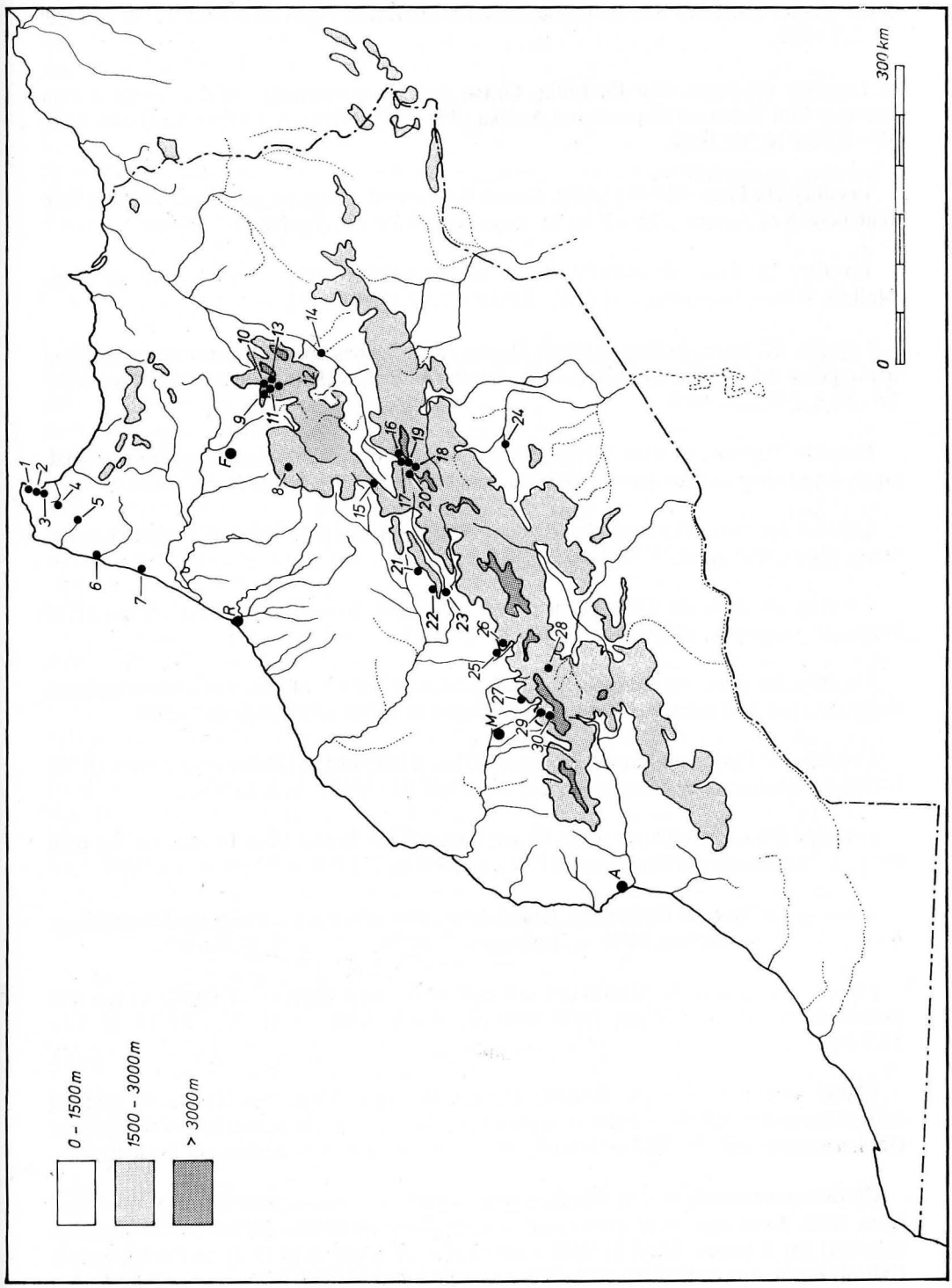
Locality 14: Prov. de Taza; Outat-Oulad-El-Haj - Missour (S 329), 29 km SW of Outat-Oulad-El-Haj, roadside and stony fields, 850 m, 3°57' W - 33°09' N, 14.4.1987.

Locality 15: Prov. de Khenifra; Moyen Atlas, Tizi n'Tahhout-ou-Fillali on the road (P 33) between Zeida and Khenifra, oak-forest, 2070 m, 5°27' W - 32°41' N, 4.7.1989.

Locality 16: Prov. d'Er-Rachidia; Grand Atlas, 9 km NE of Tounfite along the road (3427) to Boumia, stony plains, 1810-1850 m, 5°13' W - 32°31' N, 1.7.1989.

Locality 17: Prov. d'Er-Rachidia; Grand Atlas, 13 km W of Tounfite along the road (3422) to Arhbala, near the turn-off to Sidi Yahia ou Youssef, 2000 m, river-bed, 5°21' W - 32°29' N, 1.7.1989.

Fig. 1. Map of Morocco showing the 30 localities cited in this paper.


300 km
0
0 - 1500 m
1500 - 3000 m
> 3000 m
F
R
M
A

Locality 18: Prov. d'Er-Rachidia; Grand Atlas, gorge "Arhbalou n'Oussaka" between Jebel Masker and Jebel Bou Ijallabene, Assaka, limestone, 1950-2000 m, 5°22' W - 32°22' N, 2.7.1989.

Locality 19: Prov. d'Er-Rachidia; Grand Atlas, surroundings of the forest station between Sidi Yahia ou Youssef and Assaka (SW of Tounfite), c. 1900 m, roadside, 5°23' W - 32°24' N, 3.7.1989.

Locality 20: Prov. d'Er-Rachidia; Grand Atlas; north-eastern-faced flank of Jebel Bou Ijallabene S of Assaka, 2250-2500 m, limestone, 5°23' W - 32°22' N, 3.7.1989.

Locality 21: Prov. de Beni-Mellal; S of the village Foum el Ancer (NE of Beni-Mellal), 700 m, limestone, 6°15' W - 32°23' N, 5.7.1989.

Locality 22: Prov. de Beni-Mellal; Moyen Atlas, slopes above Afourer along the road to Azilal (S 508), N facing slopes at the heigth of the pass, 860-1200 m, limestone, 6°32' W - 32°11' N, 5.7.1989.

Locality 23: Prov. de Beni-Mellal; Moyen Atlas, S of Afourer along the road to Azilal, south-faced slopes of the pass, limestone, 1320 m, 6°32' W - 32°09' N, 5.7.1989.

Locality 24: Prov. d'Er-Rachidia; Erfoud - Tinejdad (3451), 12 km E of Tinejdad, sandy-stony plains, 980 m, 4°54' W 31°33' N, 16.4.1987.

Locality 25: Prov. de Marrakech; Grand Atlas, Imi-n-Ifri (Pont naturel), 6 km SE of Demnate, limestone, 1020 m, 6°58' W - 31°43' N, 7.7.1989.

Locality 26: Prov. de Marrakech; Grand Atlas, 11 km S of Imi-n-Ifri (Pont naturel) along the road to Toufrine, 1600 m, stony slopes, 6°57' W - 31°35' N, 6.7.1989.

Locality 27: Prov. de Marrakech; Grand Atlas, 2 km N of Ait Bakra on the road (P 31) between Marrakech and Ouarzazate, 1340 m, 7°25' W - 31°28' N, 8.7.1989.

Locality 28: Prov. d'Ouarzazate; Grand Atlas, 5 km S of Tizi-n-Tichka, on the road between Marrakech and Ouarzazate (P 31), c. 2000 m, 7°23' W - 31°15' N, 8.7.1989.

Locality 29: Prov. de Marrakech; Grand Atlas, along the road to Oukaimeden (6035), c. 6 km below Oukaimeden, 2400 m, dry slopes, 7°49' W - 31°12' N, 13.7.1989.

Locality 30: Prov. de Marrakech; Grand Atlas, surroundings of Oukaimeden and mountains SE of the village, 2600-3000 m, silicate rocks, 7°51' W - 31°11' N, 14.-15.7.1989.

Plants were raised at the Botanic Garden Berlin-Dahlem. Specimens of original collections and vouchers of cultivated plants are deposited in the herbarium of the Botanic Garden and Museum Berlin-Dahlem (B), duplicates in the private herbaria of the authors.

Chromosome numbers were obtained from somatic mitoses of root tips of plants raised from seed. Root tips were pretreated with hydroxyquinoline (0.002 molar aqueous solution) for 2 hours, fixed in 96% ethanol/glacial acetic acid (3:1) and refrigerated. Hydrolyzation was carried out with 1-2n hydrochloric acid for 10-15 minutes at 60°C. For

chromosome staining, root tips were squashed in aceto-orcein. Chromosome counts were made for several plants of a common seed origin. Five to ten metaphase stages were examined for every plant. For most of the examined taxa a photograph of the mitotic karyotype is provided.

Results

Aaronsohnia pubescens (Desf.) Bremer & Humphries ined. (= *Matricaria pubescens* (Desf.) Schultz-Bip.; = *Chlamydophora pubescens* (Desf.) Cosson & Kralik; = *Chamomilla pubescens* (Desf.) Alavi; = *Cotula pubescens* Desf.) — $2n = 18$

Locality 14, *Vogt 5332 & al.* (Fig. 2A).
Locality 24, *Vogt 5472 & al.*

This taxon was first described by Desfontaines as a member of the genus *Cotula* and was placed subsequently in *Matricaria*, *Chlamydophora* and *Chamomilla*. According to the generic concept for the tribe *Anthemideae* proposed by Bremer & Humphries (in press; pers. comm.), the taxon is better included within the formerly monotypic genus *Aaronsohnia* from the Middle East.

Our counts of $2n = 18$ for this taxon correspond with former reports by Reese (1957) and Molero & Montserrat Martí (1986) (both sub *Matricaria pubescens*). We think that the deviating count of $2n = 10$ given by Humphries & al. (1978) is erroneous and, hence, consider that the affinity to the genus *Cotula* ($x = 5$) concluded in that paper is not supported by cytological results.

Anacyclus L.

The genus *Anacyclus* was revised by Humphries (1979) and is well studied cytologically in Morocco (Humphries 1981 and Humphries & al. 1978). All studied taxa proved to be diploid with $2n = 18$ chromosomes and appeared to have very similar, uniform mitotic karyotypes. Our counts of five taxa corroborate the counts reported by Humphries as well as those of Loon & al. (1971, southern France), Loon (1974, Canary Islands), Schweizer & Ehrendorfer (1976, Portugal, France), Fernandes & Queirós (1971a, Portugal), and Delay & Petit (1971, Morocco).

Anacyclus clavatus (Desf.) Pers. — $2n = 18$

Locality 1, *Oberprieler 1736.*
Locality 8, *Oberprieler 3247* (Fig. 2B).

Anacyclus homogamos (Maire) Humphries — $2n = 18$

Locality 25, *Oberprieler 3532.*
Locality 27, *Oberprieler 3563* (Fig. 2C).

Anacyclus pyrethrum (L.) Link var. ***pyrethrum*** — $2n = 18$

Locality 12, *Oberprieler 1963* (Fig. 2D).
Locality 15, *Oberprieler 3477.*
Locality 17, *Oberprieler 3364.*

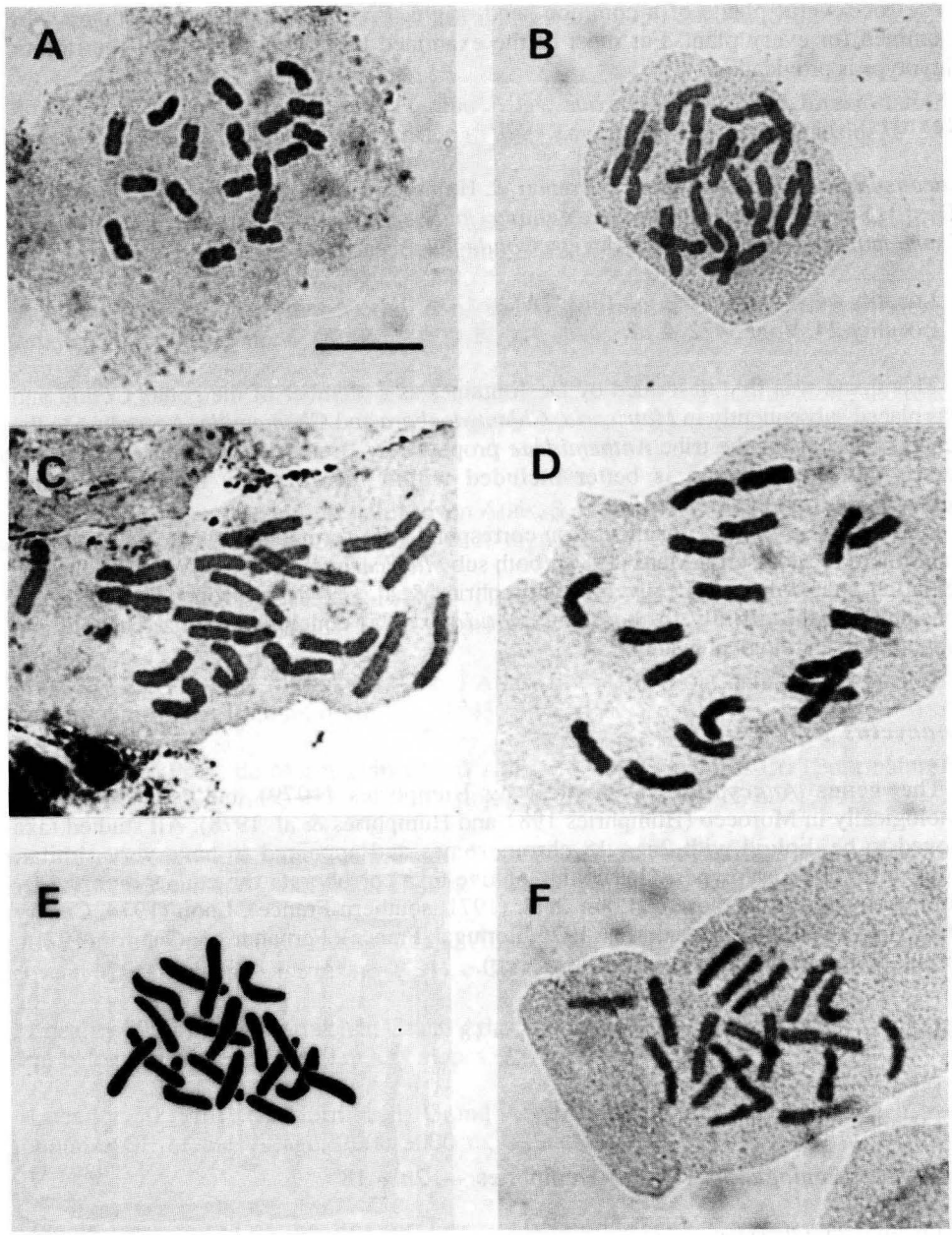


Fig. 2. Metaphases of root-tip mitoses — **A:** *Aaronsohnia pubescens*, $2n = 18$., **B:** *Anacyclus clavatus*, $2n = 18$, **C:** *Anacyclus homogamos*, $2n = 18$, **D:** *Anacyclus pyrethrum* var. *pyrethrum*, $2n = 18$, **E:** *Anacyclus radiatus* subsp. *radiatus*, $2n = 18$, **F:** *Anacyclus* x *valentinus*, $2n = 18$. (Scale: 10 µm)

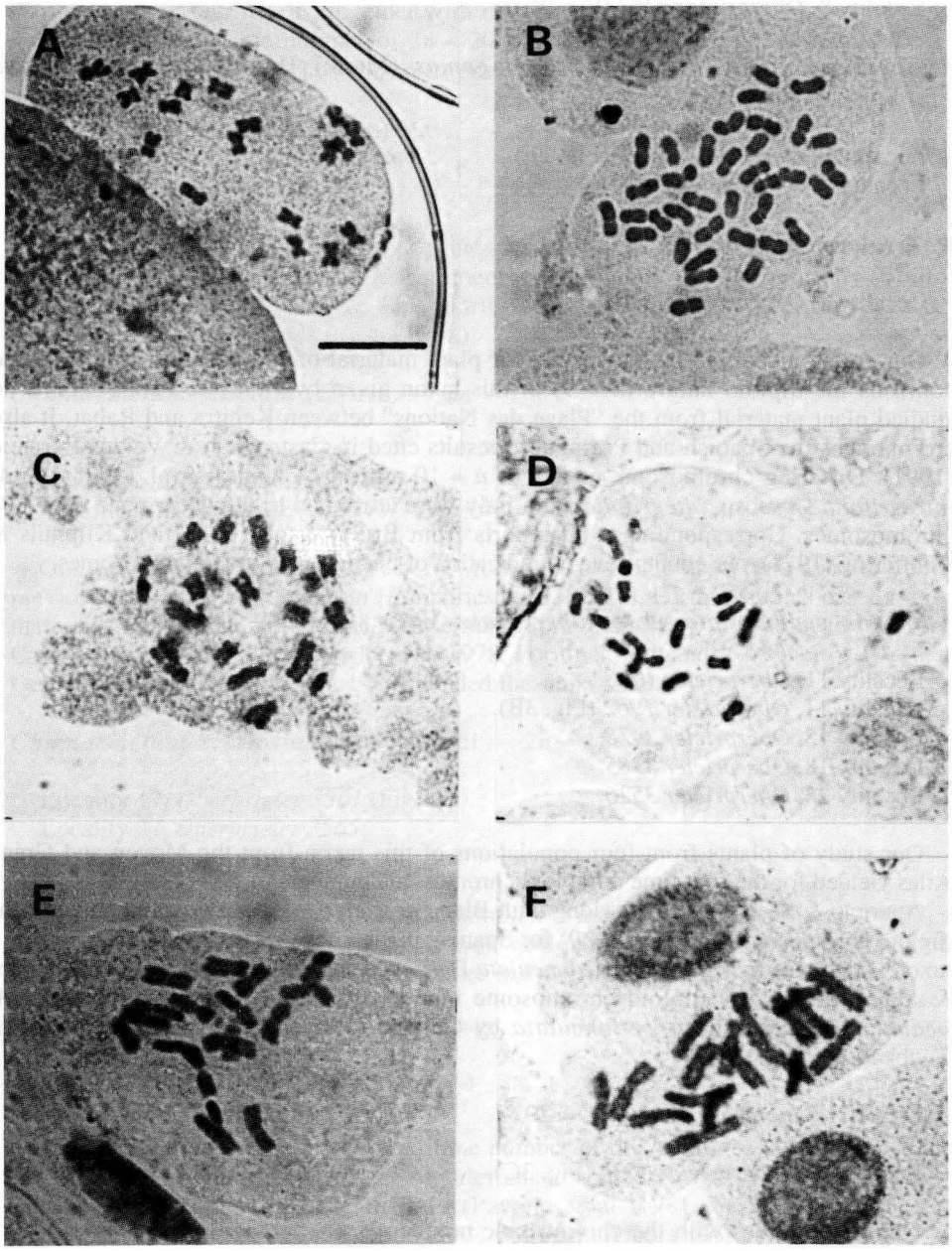


Fig. 3. Metaphases of root-tip mitoses — **A:** *Andryala integrifolia*, $2n = 18$., **B:** *Anthemis pedunculata* subsp. *tuberculata*, $2n = 36$, **C:** *Atractylis cancellata*, $2n = 20$, **D:** *Centaurea ornata*, $2n = 20$, **E:** *Chamaemelum fuscatum*, $2n = 18$, **F:** *Chamaemelum mixtum*, $2n = 18$. (Scale: 10 μm)

Anacyclus radiatus Lois. subsp. ***radiatus*** — $2n = 18$

Locality 8, *Oberprieler 3253* (Fig. 2E).

Anacyclus* x *valentinus L. (***A. homogamos*** (Maire) Humphries **x** ***A. radiatus*** Lois.) — $2n = 18$

Locality 9, *Oberprieler 1899* (Fig. 2F).
Locality 9, *Oberprieler 1919*.

Andryala integrifolia L. — $2n = 18$

Locality 2, *Oberprieler 3610* (Fig. 3A).

Our count appears to be the second for plant material of Moroccan provenience and confirms the diploid nature ($n = 9$) of this taxon given by Delay & Petit (1971) who studied plant material from the "Plage des Nations" between Kenitra and Rabat. It also corroborates the Spanish and Portuguese results cited in Castroviejo & Valdés-Bermejo (1991). Differing chromosome counts of $n = 10$ made by Capineri & al. (1978a) in *A. intregrifolia* L. subsp. *integrifolia* from Italy were attributed to the occurrence of 1-2 B-chromosomes. Corresponding with reports from Brullo & al. (1978) and Kliphuis & Wieffering (1972), our counts gave no indication of the presence of B-chromosomes.

Anthemis pedunculata subsp. ***tuberculata*** (Boiss.) Maire — $2n = 36$

Locality 11, *Oberprieler 1928*.
Locality 11, *Oberprieler 1962* (Fig. 3B).
Locality 15, *Oberprieler 3478*.
Locality 18, *Oberprieler 3385*.
Locality 26, *Oberprieler 3526*.

Our study of plants from four populations of this taxon from the Moyen and Grand Atlas yielded for the first time tetraploid chromosome numbers of $2n = 4x = 36$.

Aparicio & Silvestre (1985) along with Blanché & al. (1985) previously published the diploid chromosome number (n = 9) for Spanish plants of *Anthemis tuberculata* Boiss., a taxon which was ascribed to *A. pedunculata* Desf. as a subspecies by Maire (in Jahandiez & Maire 1934). The diploid chromosome number of $2n = 18$ was also found for *A. pedunculata* Desf. subsp. *pedunculata* by Galland (1985, 1990) in Morocco (Djebel Toubkal).

Atractylis cancellata L. — $2n = 20$

Locality 25, *Oberprieler 3536* (Fig. 3C).

Our count agrees with the chromosome number of $n = 10$ mentioned previously for Moroccan material by Humphries & al. (1978). It is also in accordance with counts reported from Italy (Bartolo & al. 1977) and the Canary Islands (Borgen 1969).

Centaurea ornata Willd. s. l. — $2n = 20$

Locality 27, *Oberprieler 3567* (Fig. 3D).

This species of *Centaurea* sect. *Acrocentron* has previously been studied cytologically from Morocco by Gardou (1975) who counted two varieties (sub *C. incana* subsp. *ornata* (Willd.) Maire). Our results, together with the results reported in the paper cited above, revealed a chromosome number of $2n = 20$ which is typical for this section with base numbers of $n = 10$ and $n = 11$ (Wagenitz; pers. comm.).

Chamaemelum fuscatum (Brot.) Vasc. — $2n = 18$

Locality 4, *Oberprieler 1778* (Fig. 3E).

This is the first count for this species based on Moroccan plant material. The chromosome number $2n = 18$ is in agreement with previous reports from Italy (Brullo & al. 1978) and Portugal (Nagl & Ehrendorfer 1974; Fernandes & Queirós 1971a & b; Queirós 1973; sub Anthemis fuscata Brot.).

Chamaemelum mixtum (L.) All. — $2n = 18$

Locality 2, *Oberprieler 1746*.
Locality 6, *Oberprieler 1803*.
Locality 7, *Oberprieler 1819* (Fig. 3F).

Our counts from three northwestern Moroccan populations of this species confirm previous reports of $n = 9$ cited in Humphries & al. (1978). Further studies based on plant material from central and western Mediterranean proveniences (Albania: Strid 1971; Italy: Capineri & al. 1978b, and Bartolo & al. 1978; Portugal: Fernandes & Queirós 1971a, and Queirós 1973; Spain: Silvestre 1986) yielded the same result.

Chamaemelum scariosum (Ball) Benedí — $2n = 18$

Locality 17, *Oberprieler 3361* (Fig. 4A).
Locality 27, *Oberprieler 3565*.
Locality 28, *Oberprieler 3583*.

Our counts corroborate previous reports of $n = 9$ made by Humphries & al. (1978, sub *Ormenis scariosa* (Ball) Litard. & Maire). Following Benedí i Gonzáles (1988) this Moroccan endemic perennial is better placed in the genus *Chamaemelum* Miller.

Chrysanthemum segetum L. — $2n = 18$

Locality 5, *Vogt 6186 & al.* (Fig. 4B).

This is the first record of a chromosome number of this common Mediterranean weed for Morocco. Previous counts in the Mediterranean area also yielded a diploid number of chromosomes and were made in Italy (Pavone & al. 1981, Scrugli 1974), Portugal (Fernandes & Queirós 1971a, Queirós 1973) and Spain (Ubera 1983).

Cladanthus arabicus (L.) Cass. — $2n = 18$

Locality 23, *Oberprieler 3502* (Fig. 4C).

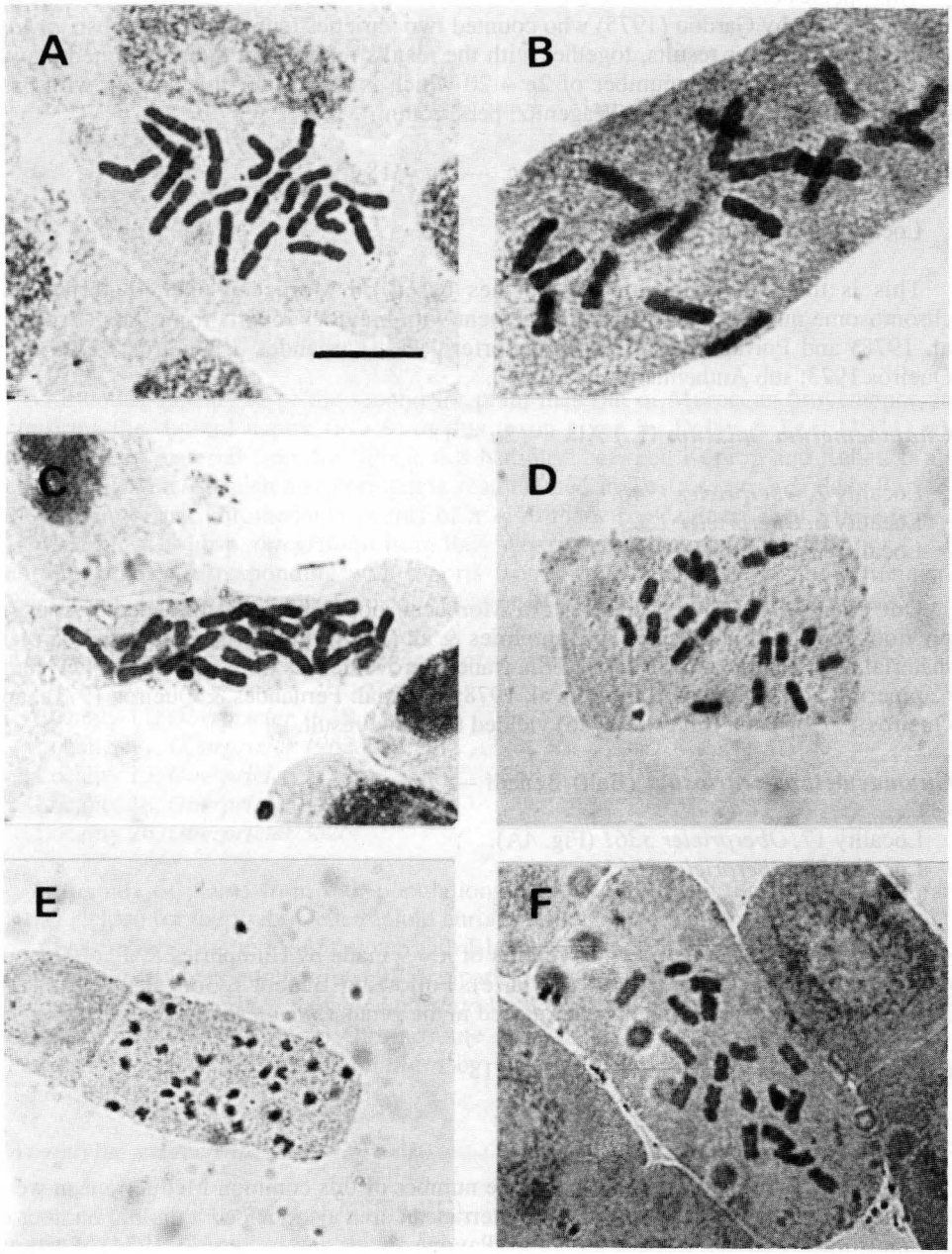


Fig. 4: Metaphases of root-tip mitoses — A: *Chamaemelum scariosum*, $2n = 18$, **B:** *Chrysanthemum segetum*, $2n = 18$, **C:** *Cladanthus arabicus*, $2n = 18$, **D:** *Cotula coronopifolia*, $2n = 20$, **E:** *Crupina vulgaris*, $2n = 30$, **F:** *Erigeron acer* subsp. *mesatlanticus*, $2n = 18$. (Scale: 10 µm)

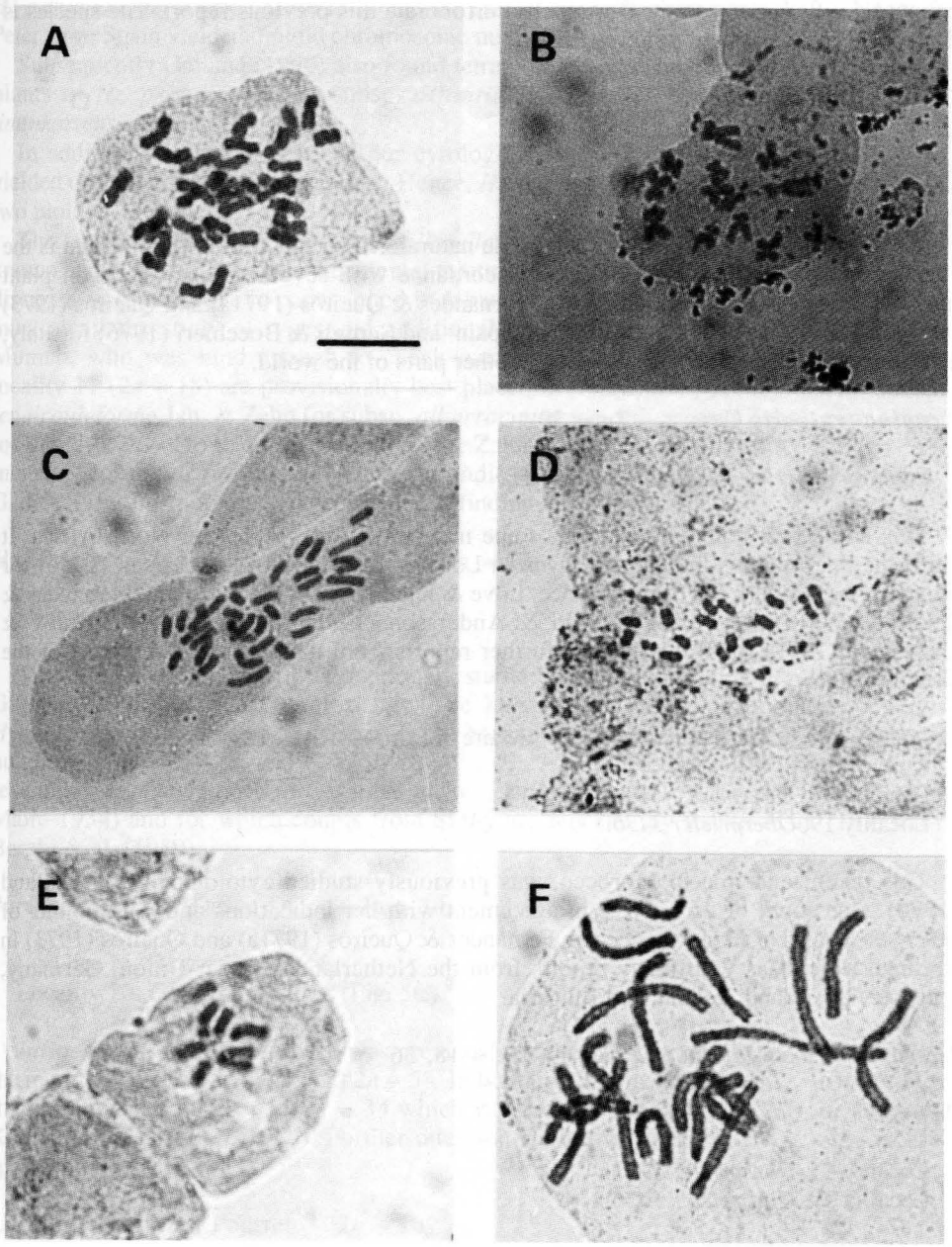


Fig. 5. Metaphases of root-tip mitoses — **A:** *Hieracium pseudopilosella*, $2n = 36$, **B:** *Hypochaeris leontodontoides*, $2n = 12$, **C:** *Jurinea humilis*, $2n = 34$, **D:** *Lactuca tenerrima*, $2n = 16$, **E:** *Leontodon saxatilis* subsp. *longirostris*, $2n = 8$, **F:** *Nivellea nivellei*, $2n = 18$. (Scale: 10 µm)

This species was studied cytologically only once before by Talavera & al. (1984) who counted $n = 9$ chromosomes. Our results corroborate this previous report. The species is distributed from southern Spain to Libya.

Cotula coronopifolia L. — $2n = 20$

Locality 2, *Oberprieler 1749*.
Locality 3, *Oberprieler 1762* (Fig. 4D).

Our count of $2n = 20$ for this world-wide naturalized species from South Africa is the first report for North Africa and is in accordance with several counts made on plant material of European proveniences, e.g. Fernandes & Queirós (1971a) and Queirós (1973) for Portugal, Björkqvist & al. (1969) for Spain, and Scrugli & Bocchieri (1976) for Italy, as well as numerous other counts made in other parts of the world.

Crupina vulgaris Cass. — $2n = 30$

Locality 30, *Oberprieler 3629* (Fig. 4E).

This is the first report of a chromosome number of this species for North Africa. It confirms the previous indications given in Loon & Kieft (1980) and Larsen (1956) for Yugoslavia, Couderc (1979) for France, Löve & Kjellqvist (1974) for Spain, Fernandes & Queirós (1971a) for Portugal, Strid & Andersson (1985) for Greece, Kuzmanov & Georgieva (1977) for Bulgaria, and further reports from the western Asian part of the species' range.

Erigeron acer subsp. ***mesatlanticus*** (Maire) Maire — $2n = 18$

Locality 19, *Oberprieler 3435* (Fig. 4F).
Locality 19, *Oberprieler 3436*.

This taxon, endemic to Morocco, was previously studied cytologically by Galland (1990). Our count of $2n = 18$ is in agreement with her indications and with counts of other subspecies of *Erigeron acer* by Fernandes & Queirós (1971a) and Queirós (1973) in Portugal as well as with many reports from the Netherlands, Soviet Union, Germany, Yugoslavia, Finland, Poland, and Bulgaria.

Hieracium pseudopilosella Ten. — $2n = 18, 36$

$2n = 18$

Locality 11, *Oberprieler 1931*.
Locality 29, *Oberprieler 3626*.

$2n = 36$

Locality 15, *Oberprieler 3471* (Fig. 5A).

The chromosome number of an individual of *H. pseudopilosella* from Morocco was mentioned for the first time in a paper by Merxmüller (1975) dealing with diploid

members of the genus *Hieracium*. In his paper a tetraploid chromosome number for *H. pseudopilosella* subsp. *atlantis* Zahn is cited, while on the other hand two counts made on *H. pseudopilosella* s. str. from Italy and *H. pseudopilosella* subsp. *tenuicaule* Naeg. & Peter from Spain yielded diploid chromosome numbers.

Subsequently Galland (1990) also found tetraploid chromosome numbers in Moroccan plants of *H. pseudopilosella* subsp. *atlantis* Zahn and *H. pseudopilosella* subsp. *timinkariense* Zahn.

In addition to these indications our cytological study of Moroccan populations also yielded diploid chromosome numbers. Hence, *H. pseudopilosella* is represented by at least two ploidy levels there.

The taxonomy of *Hieracium pseudopilosella*, especially in North Africa, is still poorly known and dates back to the fundamental treatment of Zahn (1923) and a few subsequent discriptions of new taxa in papers cited in Jahandiez & Maire (1934). Final identification must await the study of types and additional material. Nevertheless Dr. W. Lippert, Munich, who was kind enough to check our specimens, concluded that plants from locality 11 ($2n = 18$) are provisionally best placed in *Hieracium pseudopilosella* subsp. *tenuicauleforme* Jah. & Zahn (or subsp. *albarracinum* var. *minoriceps* Zahn), plants from locality 29 ($2n = 18$) in subsp. *timinkariense* Zahn, and plants from locality 15 ($2n = 36$) in subsp. *subtenuicaule* Zahn. Hence, the indication for subsp. *timinkariense* given by Galland (1990) is not in agreement with our findings.

Hypochaeris leontodontoides Ball — $2n = 12$

Locality 18, *Oberprieler 3399* (Fig. 5B).

This Moroccan endemic was previously studied cytologically by Quézel (1957) and Galland (1990) with the same result. The karyologically well differentiated genus *Hypochaeris comprises* c. 12 species in the Mediterranean area, with basic chromosome numbers of $n = 3$, 4, 5, and 6. With $2n = 12$, *H. leontodontoides* Ball caryologically resembles *H. laevigata* (L.) Cesati & al. which also occurs in Morocco (Jahandiez & Maire 1934) and for which counts from Sicily are reported by Brullo & al. (1977) and Barghi & al. (1989).

Jurinea humilis (Desf.) DC. — $2n = 34$

Locality 15, *Oberprieler 3461*.
Locality 26, *Oberprieler 3518* (Fig. 5C).

Jurinea humilis from Morocco was previously studied by Humphries & al. (1978) with the reported results of $2n = 24$ and $2n = 58$. In both population studied here, counts yielded the chromosome number of $2n = 34$ which is a confirmation of reports from Spain by Küpfer (1969a, 1969b, 1974). Further attention should be paid to the cytology of this species in Morocco.

Lactuca tenerrima Pourret — $2n = 16$

Locality 26, *Oberprieler 3524* (Fig. 5D).

Our results correspond with reports for this taxon cited in Humphries & al. (1978) for material from the Grand Atlas and Anti-Atlas and confirms the diploid nature of this species in Morocco.

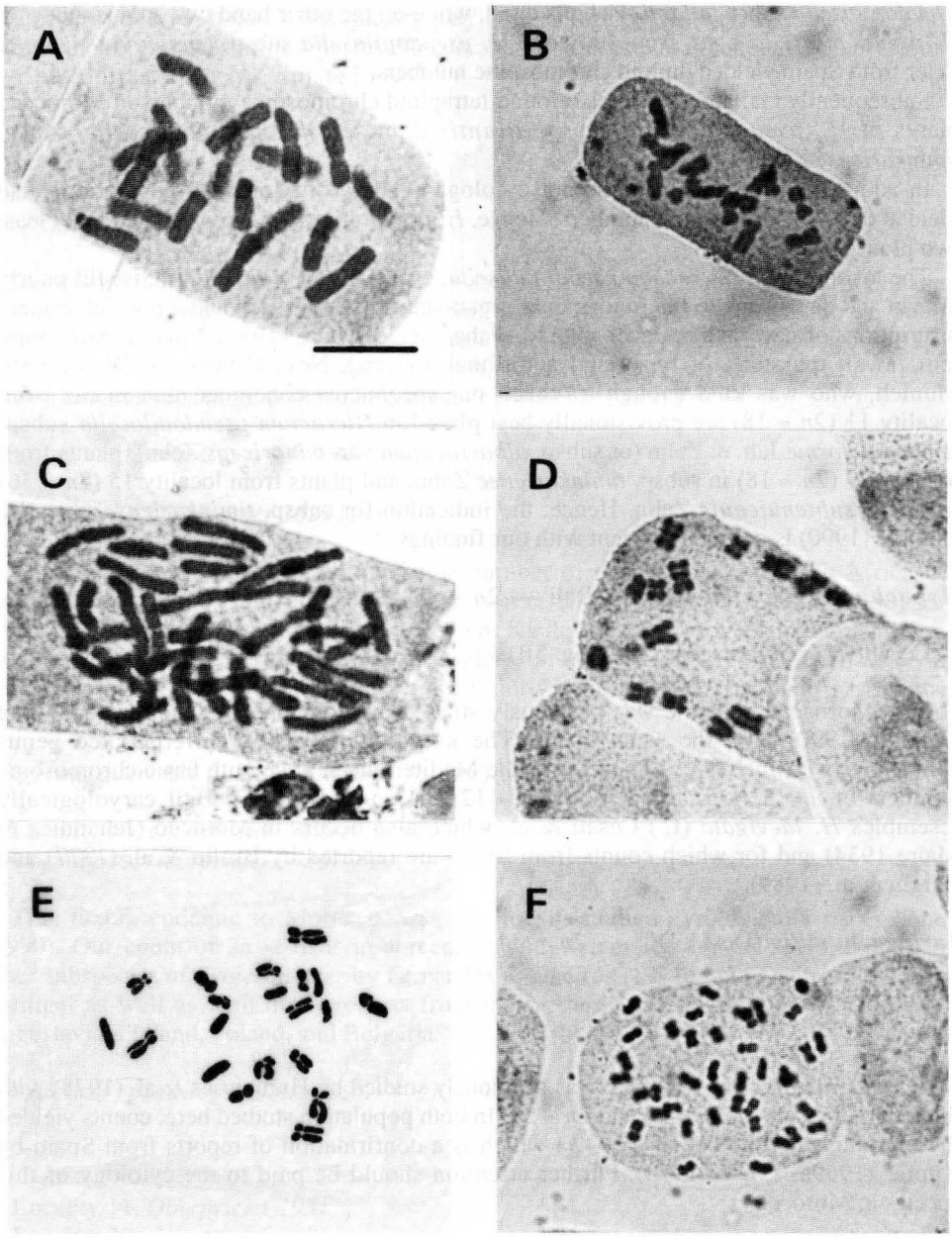


Fig. 6. Metaphases of root-tip mitoses — **A:** *Otospermum glabrum*, $2n = 18$, **B:** *Pseudognaphalium luteo-album*, $2n = 14$, **C:** *Santolina rosmarinifolia* subsp. *canescens*, $2n = 36$, **D:** *Scorzonera laciniata* subsp. *calcitrapifolia*, $2n = 14$, **E:** *Senecio glaucus* subsp. *coronopifolius*, $2n = 20$, **F:** *Senecio lividus*, $2n = 40$. (Scale: 10 µm)

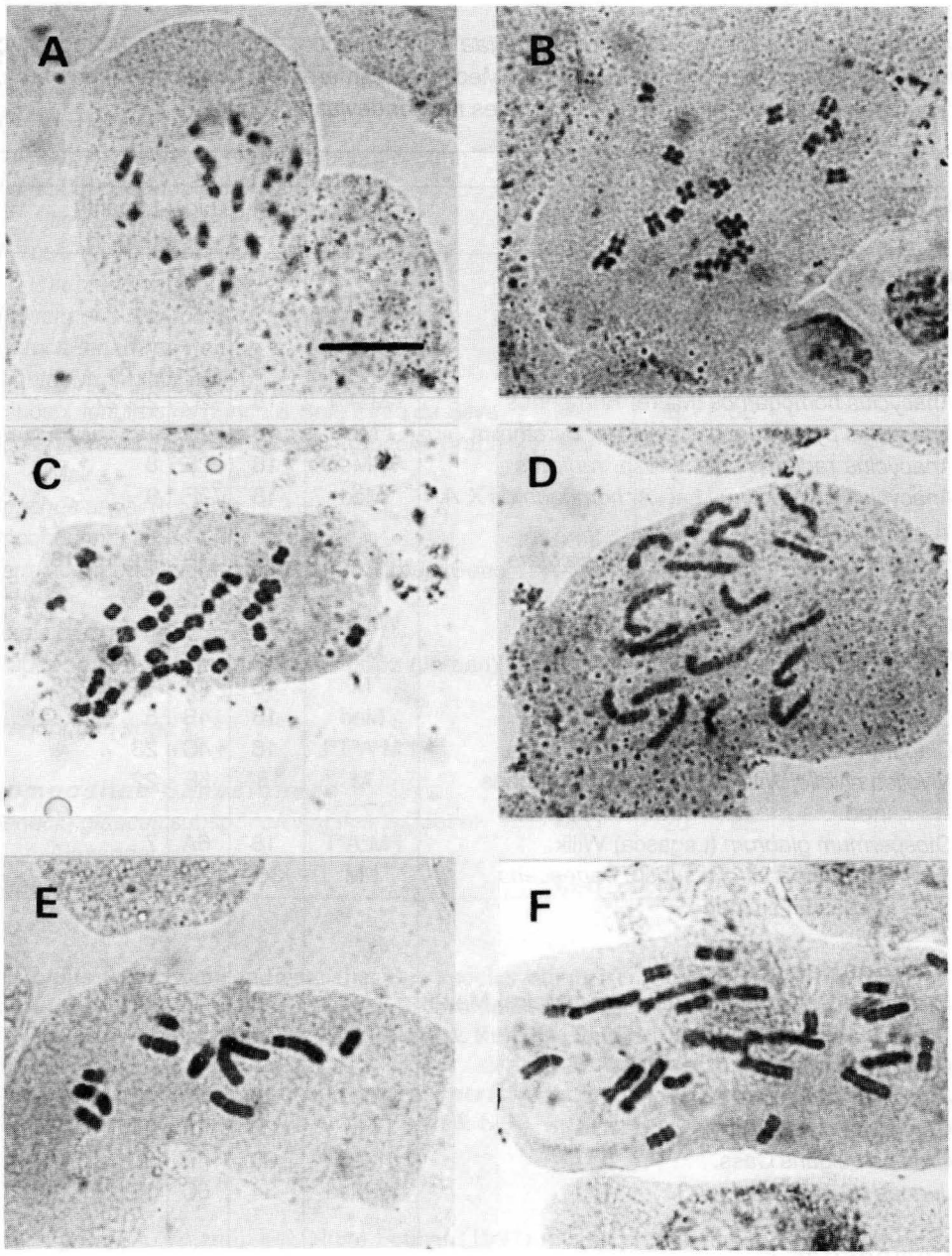


Fig. 7. Metaphases of root-tip mitoses — **A:** *Sonchus asper*, $2n = 18$, **B:** *Sonchus maritimus*, $2n = 18$, **C:** *Taraxacum obovatum* subsp. *ochrocarpum*, $2n = 32$, **D:** *Tolpis barbata*, $2n = 18$, **E:** *Tragopogon porrifolius* subsp. *australis*, $2n = 12$, **F:** *Tragopogon spec.*, $2n = 24$. (Scale: 10 µm)

Table 1: Chromosome counts of *Compositae* from Morocco. - I: Iberia, M: Morocco, A: Algeria, T: Tunisia, L: Libya, W-Med: West Mediterranean area, Med: Mediterranean area, cosm: cosmopolitan. - An asterisk (*) indicates new or deviating counts.

Taxon	Areal	2n	Fig.	Locality (Fig. 1)
Compositae-Anthemideae				
Aaronsohnia pubescens (Desf.) Bremer & Humphries ined.	M°A°T°L	18	2A	14, 24
Anacyclus clavatus (Desf.) Pers.	Med	18	2B	1, 8
Anacyclus homogamos (Maire) Humphries	I°M°A°T	18	2C	25, 27
Anacyclus pyrethrum (L.) Link var. pyrethrum	I°M°A	18	2D	12, 15, 17
Anacyclus radiatus Lois. subsp. *radiatus*	W-Med	18	2E	8
Anacyclus X *valentinus* L. (=*A. homogamos* X *A. radiatus*)	Med	18	2F	9
Anthemis pedunculata subsp. *tuberculata* (Boiss.) Maire	I°M°A°T	36*	3B	11, 15, 18, 26
Chamaemelum fuscatum (Brot.) Vasc.	W-Med	18	3E	4
Chamaemelum mixtum (L.) All.	Med	18	3F	2, 6, 7
Chamaemelum scariosum (Ball) Benedí	M	18	4A	17, 27, 28
Chrysanthemum segetum L.	Med	18	4B	5
Cladanthus arabicus (L.) Cass.	I°M°A°T°L	18	4C	23
Nivellea nivellei Wilcox, Bremer & Humphries ined.	M	18*	5F	22
Otospermum glabrum (Lagasca) Willk.	I°M°A°T	18	6A	7
Santolina rosmarinifolia subsp. *canescens* (Lagasca) Nyman	I°M	36*	6C	16
Compositae-Astereae				
Erigeron acer subsp. *mesatlanticus* (Maire) Maire	M	18	4F	19
Compositae-Cardueae				
Atractylis cancellata L.	Med	20	3C	25
Centaurea ornata Willd.	I°M	20	3D	27
Crupina vulgaris Cass.	Med	30	4E	30
Jurinea humilis (Desf.) DC.	W-Med	34	5C	15, 26
Compositae-Cotuleae				
Cotula coronopifolia L.	cosm.	20	4D	2, 3
Compositae-Inuleae				
Pseudognaphalium luteo-album (L.) Hilliard & Burtt	cosm.	14	6B	17

Taxon	Areal	2n	Fig.	Locality (Fig. 1)
Compositae-Lactuceae				
Andryala integrifolia L.	Med	18	3A	2
Hieracium pseudopilosella aff. subsp. *tenuicauleforme* Jahand. & Zahn	M	18*	–	11
Hieracium pseudopilosella aff. subsp. *timinkariense* Zahn	M	18*	–	29
Hieracium pseudopilosella aff. subsp. *subtenuicaule* Zahn	M	36*	5A	15
Hypochaeris leontodontoides Ball	M	12	5B	18
Lactuca tenerrima Pourret	W-Med	16	5D	26
Leontodon saxatilis subsp. *longirostris* (Finch & Sell) Pinto da Silva	Med	8	5E	1
Scorzonera laciniata subsp. *calcitrapifolia* (Vahl) Maire	Med	14	6D	15
Sonchus asper (L.) Hill	cosm.	18	7A	11
Sonchus maritimus L.	Med	18	7B	28
Taraxacum obovatum subsp. *ochrocarpum* Soest	W-Med	32	7C	12, 13, 15, 20
Tolpis barbata (L.) Gaertner	Med	18	7D	21
Tragopogon porrifolius subsp. *australis* (Jordan) Nyman	Med	12	7E	10, 26
Tragopogon spec.		24*	7F	15
Compositae-Senecioneae				
Senecio glaucus subsp. *coronopifolius* (Maire) Alexander	Med	20	6E	17
Senecio lividus L.	Med	40	6F	17

Counts from Spain indicate that this species comprises two ploidy levels there. In addition to diploids ($2n = 16 + 1$-2 B-chromosomes; Cueto Romero & Blanca López 1987) also tetraploid plants ($n = 16$; Ubera & Ruiz de Clavijo 1984) were found.

Leontodon saxatilis subsp. ***longirostris*** (Finch & Sell) Pinto da Silva (*L. taraxacoides* subsp. *longirostris* Finch & Sell) — $2n = 8$

Locality 1, *Oberprieler 1739* (Fig. 5E).

According to Izuzquiza & Nieto Feliner (1991) this taxon belongs to *Leontodon* sect. *Thrincia* (Roth) Bentham & Hooker (subg. *Leontodon*), which is characterized by heteromorphic achenes, capitula nodding in bud, and a chromosome number of $2n = 8$.

Our count is the first chromosome number report from North Africa for this taxon and agrees with indications by Devesa (1983), Luque & al. (1983), Izuzquiza & Nieto Feliner (1991) and Dalgaard (1987) for the Spanish mainland, Ibiza, and Lanzarote, respectively.

Nivellea nivellei (Braun-Blanquet & Maire) Wilcox & al. ined. (Chrysanthemum *nivellei* Braun-Blanquet & Maire) — $2n = 18$

Locality 22, *Oberprieler 3494* (Fig. 5F).

This is the first count based on authentic material of this Moroccan endemic. A previous report of $2n = 18$ has been given by Dowrick (1952; sub *Chrysanthemum nivellei*) using plant material of unknown origin.

According to a new generic arrangement of the *Compositae-Anthemideae* proposed by Bremer & Humphries (in press), this species will be placed in the new, monotypic genus *Nivellea*.

Otospermum glabrum (Lagasca) Willk. — $2n = 18$

Locality 7, *Oberprieler 1820* (Fig. 6A).

Our count of $2n = 18$ chromosomes for this species corroborates the results of Talavera & al. (1984; $n = 9$) and Aparicio (1989; $n = 9$), who also studied North African plant material. The same diploid chromosome number was reported by Fernandes & Queirós (1971a) and Queirós (1973; sub *Matricaria glabra*) from the Iberian peninsula, whereas Gallego Martín & al. (1984) found a tetraploid plant with $2n = 36$ in the province of Cádiz.

Pseudognaphalium luteo-album (L.) Hilliard & Burtt — $2n = 14$

Locality 17, *Oberprieler 3375* (Fig. 6B).

Moroccan material of this world-wide introduced species was studied cytologically for the first time by Galland (1990, sub *Gnaphalium luteo-album* L.). Our result of $2n = 14$ corresponds with her count and with former reports from other regions (Fernandes & Queirós 1971a, Björkqvist & al. 1969, Löve & Kjellqvist 1974, Ruiz de Clavijo Jiménez 1990).

Santolina rosmarinifolia aff. subsp. ***canescens*** (Lag.) Nyman — $2n = 36$

Locality 16, *Oberprieler 3360* (Fig. 6C).

This is the first count for this taxon for Morocco.

Tetraploid chromosome numbers of $2n = 36$ in *S. rosmarinifolia* L. s.l. were reported only twice from the Iberian peninsula. Fernandes & Queirós (1971b) assign the tetraploid number to *S. rosmarinifolia* s. str. from south Portugal, while Valdes-Bermejo & Autúnez (1981) report this number for *S. rosmarinifolia* subsp. *pectinata* (Lag.) Guinea from Andalusia.

Although the taxonomy of *S. rosmarinifolia* is not yet totally understood, we tend to the opinion that the plants studied by us belong to *S. canescens* Lag., a taxon which is supposed to be morphologically intermediate between *S. rosmarinifolia* s.str. and *S. pectinata* Lag., as circumscribed by Valdés-Bermejo & López (1977) in Spain.

Our count of $2n = 36$ for *S. canescens*, together with a diploid chromosome number for Moroccan plants of *S. pectinata* reported by Molero & Montserrat Martí (1986; sub *S. rosmarinifolia* subsp. *pectinata*), is in striking contrast to chromosome counts on Spanish populations by Valdés-Bermejo & Antúnez (1981) who refer the diploid chromosome

number to *S. canescens* (sub *S. rosmarinifolia* subsp. canescens) and the tetraploid number to *S. pectinata* (sub *S. rosmarinifolia* subsp. *pectinata*).

Scorzonera laciniata subsp. ***calcitrapifolia*** (Vahl) Maire — $2n = 14$

Locality 15, *Oberprieler 3470* (Fig. 6D).

Previous reports for plants of Moroccan provenance are not known. Our results of $2n = 14$ agrees with the indications for Spain (Díaz de la Guardia & Blanca López 1978) and other parts of the wide range (e.g. Nazarova 1980) of this taxon.

In contrast to the other subgenera of *Scorzonera* the members of *S.* subg. *Podospermum* (DC.) Lipsic are characterised by a distinct, asymetrical karyotype.

Senecio glaucus subsp. ***coronopifolius*** (Maire) Alexander — $2n = 20$

Locality 17, *Oberprieler 3369* (Fig. 6E).

Our count corroborates the reports of Alexander (1979) who also examined Morroccan plants. The species is distributed from the Canary Islands to the western Himalaya and was found to be diploid, as counts by Nordenstam (1972) for Egypt also indicate. Reports of a tetraploid chromosome number ($2n = 40$) by Mehra & Remanandan (1969) from the eastern part of the species' range are supposed to be due to misidentification (Alexander 1979).

Senecio lividus L. — $2n = 40$

Locality 17, *Oberprieler 3363* (Fig. 6F).

Our count of $2n = 40$ is the first one reported for this annual, glandular representative of *Senecio* sect. *Senecio* for Morocco and corresponds with previous counts of Fernandes & Queirós (1971a) who studied Portuguese, and Marchi (1971) who used Italian plant material.

Sonchus asper (L.) Hill — $2n = 18$

Locality 11, *Oberprieler 1925* (Fig. 7A).

The chromosome number of $2n = 18$ agrees with the indication of Talavera & al. (1984) who also studied Moroccan plant material. Further Mediterranean reports with the same result are these of Marchi (1971), Fernandes & Queirós (1971a), Löve & Kjellqvist (1974), Fernández Casas & al. (1980), and Nordenstam (1972).

Sonchus maritimus L. — $2n = 18$

Locality 28, *Oberprieler 3584* (Fig. 7B).

The chromosome number of $2n = 18$ is the first report for North African plants of this species. The same number was given by Fernandes & Queirós (1971a) and Queirós (1973) for Portugal, Löve & Kjellqvist (1974), Valdés-Bermejo & Castroviejo (1977), Fernández

Casas & Machín Santamaría (1977), Luque (1983), Silvestre (1983), and Mejías & Valdés (1988) for Spain, and Brullo & al. (1979) for Italy.

Taraxacum obovatum subsp. ***ochrocarpum*** Soest (***T. atlanticum*** Lindb. f.) — $2n = 32$

Locality 12, *Oberprieler 1968*.
Locality 13, *Oberprieler 1946*.
Locality 15, *Oberprieler 3469* (Fig. 7C).
Locality 20, *Oberprieler 3416*.

Plants from four Moroccan populations of this common western Mediterranean taxon, proved to be tetraploid with $2n = 4x = 32$. This result is in agreement with these of Richards (1969), Humphries & al. (1978), Björkqvist & al. (1969), and Brullo & al. (1977).

Tolpis barbata (L.) Gaertner — $2n = 18$

Locality 21, *Oberprieler 3491* (Fig. 7D).

This species has not been previously studied cytologically for Morocco. Our count of $2n = 18$ fits with reports from Spain (Talavera 1981, Gadella & al. 1966), Portugal (Fernandes & Queirós 1971a, Queirós 1973), France (Delay 1971), and Canary Islands (Dalgaard 1986).

Tragopogon porrifolius subsp. ***australis*** (Jordan) Nyman — $2n = 12$

Locality 10, *Oberprieler 1916* (Fig. 7E).
Locality 26, *Oberprieler 3517*.

Our counts of $2n = 12$ using plant material from Grand and Moyen Atlas are in agreement with the only previous report for Morocco, by Humphries & al. (1978), as well as with several other indications from the European part of the Mediterranean area given by Ubera (1981), Ruiz de Clavijo Jiménez & Ubera Jiménez (1982), Dahlgren & al. (1971), Capineri & al. (1976), and Delay (1970).

Tragopogon spec. — $2n = 24$

Locality 15, *Oberprieler 3457* (Fig. 7F).

This is the first record of a tetraploid chromosome number ($2n = 4x = 24$) for a member of the genus *Tragopogon* in North Africa.

Tetraploid plants in *Tragopogon* are usually presumed to be of allopolyploid origin. For the Spanish species *T. castellanus* Levier ($2n = 24$) Wilson (1983) suggests the two diploid species *T. porrifolius* L. and *T. crocifolius* L. as putative parents. Ownbey & McCollum (1954) express similar views for the North American tetraploids *T. mirus* (*T. dubius* and *T. porrifolius*) and *T. miscellus* (*T. dubius* and *T. pratensis*).

For Morocco only the two diploid species *T. porrifolius* and *T. crocifolius* are reported so far (Jahandiez & Maire 1934), but further studies are needed before concluding on the origin of the tetraploid.

Acknowledgements

We would like to thank Prof. W. Greuter for valuable comments in the final draft of this paper. The skilful cultivation of our collections by Mr. Ch. Schiers and the technical assistance of Mrs. M. Schröder and Mrs. A. Schreiber is gratefully acknowledged as well as the improving of our English by Dr. R. M. Beauchamp.

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