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Chromosome numbers in the Iranian Umbelliferae

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Abstract. Among 33 species in 24 genera of the Iranian Umbelliferae studied, the species of *Calyptrosciadium* Rech.f *et* Kuber, *Demavendia* Pimenov, and *Rhabdosciadium* Boiss. studied here showed the diploid chromosome number of $2n=22$ with the basic chromosome number of $x=11$ as well as 21 species and one subspecies of other genera were recorded for the first time. The majority of the species investigated was diploid. *Pimpinella deverroides* and *Leiotulus secacul* subsp. *aucheri* were tetraploids. Infraspecific variability of chromosome numbers has been revealed in Iranian populations of *Pimpinella tragium* and resulted that the plants of Alborz Mts. studied were diploids while those of Zagros Mts. studied were tetraploids.

Keywords : Chromosome numbers, Iran, Karyotaxonomy, Umbelliferae (Apiaceae)

Introduction

Iran is the most essential diversity center of the Umbelliferae not only in the Eastern Hemisphere but in global scale called the Irano-Turanian or the SW Asian area in various floristic regions.

Chromosomes of the Iranian Umbelliferae have been poorly investigated and characterized and determinations of chromosome numbers based on local materials of the family have been especially limited. The Umbelliferae flora of Iran is very rich, is the third largest after that of the People's Republic of China and Turkey, and consists of 363 species in 114 genera of which 113 species and 46 genera are endemic (Pimenov, 2004 ; with small current correction). Among the chromosome counts of 168 species of the Umbelliferae distributed in Iran documented up to date, the majority has been counted and recorded data elsewhere other than Iran (Pimenov *et al.*, 2002). Thus, only 22 chromosome determinations for 20 species in 11 genera (see Table 1) have been made in the Iranian materials (Leute and Speta, 1972 ; Perdigo i Ariso, 1981 ; Küpfer, 1982 ; Cartier, 1983 ; Aryavand, 1983 ; Ghaffari and Chariat-Panahi, 1985 ; Ghaffari, 1986, 1987 ; Herrnstadt and Heyn, 1977 ; Lamond, 1990 ; Sheidai *et al.*, 1996)

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Materials and methods

During the joint Russian-Iranian expedition in 2001 plant materials such as flower buds and fruits were collected in their native habitats for large set of local Umbelliferae taxa in various Provinces called "Ostans of Iran" such as Tehran, Ghom, Esfahan, Chaharmahal va Bakteyary, Boyerahmad va Kohgiluye, Fars, Arak, Hamadan, Lorestan and Khorassan. Seeds of some species collected were sown and germinated in the Botanical Garden of Moscow State University. The voucher specimens were deposited in the Herbarium of Moscow State University (MW).

Meiotic chromosomes were examined in pollen mother cells. Flower buds were fixed in the 3 : 1 mixture of 96% ethanol and glacial acetic acid and then, stained in 1% acetocarmine for 3-4 days at about 5°C. After staining anthers were dissected.

Somatic chromosomes were examined in root meristematic cells of seedlings. After root tips were pretreated in 0.01% colchicine at room temperature for 3 h, they were fixed in 3 : 1 mixture of 96% ethanol-glacial acetic acid and then stained with 1% acetocarmin at 100°C for 3-5 minutes. Both the anthers and the root tips were squashed on a glass slide in chloralhydrate.

Table 1. Chromosome numbers of Iranian Umbelliferae previously documented on the basis of Iranian plant materials

No	Species	n	2n	References
1.	*Anisosciadium orientale* DC.	11		Ghaffari, 1986, 1987
2.	*Azilia eryngioides* (Pau) Hedge *et* Lamond		22	Lamond, 1990
3.	*Bunium chaerophylloides* (Regel *et* Schmalh.) Drude		12	Sheidai *et al.*, 1996
4.	*B. cylindricum* (Boiss. *et* Hohen.) Freyn		20	Sheidai *et al.*, 1996
5.	*B. persicum* (Boiss.) B. Fedtsch.		14	Sheidai *et al.*, 1996
6.	*Bupleurum exaltatum* M. Bieb.	6		Küpfer, 1982
7.	*B. lancifolium* Hornem.	8		Ghaffari, 1987
8.	*Carum carvi* L.		20	Sheidai *et al.*, 1996
9.	*Cuminum cyminum* L.		14	Sheidai *et al.*, 1996
10.	*Ducrosia anethifolia* (DC.) Boiss.		22	Cartier, 1983
		11		Ghaffari, 1987
11.	*Eryngium billardieri* F. Delaroche		16	Perdigo i Ariso, 1981
12.	*E. carlinoides* Boiss. f. *subulatum* H. Wolff		14	Perdigo i Ariso, 1981
13.	*E. creticum* Lam.		14	Perdigo i Ariso, 1981
14.	*E. thyrsoideum* Boiss.		16	Perdigo i Ariso, 1981
15.	*Heracleum persicum* Desf. *ex* Fisch.	11		Aryavand, 1983
16.	*Pimpinella eriocarpa* Banks *et* Sol.		18	Leute and Speta, 1972
17.	*P. tragium* Vill.	20+1B		Küpfer, 1982
18.	*Prangos haussknechtii* Boiss.		66	Herrnstadt and Heyn, 1977
19.	*P. ferulacea* (L.) Lindl.		66	Herrnstadt and Heyn, 1977
			34	Ghaffari and Chariat-Panahi, 1985
20.	*P. gaubae* (Bornm.) Herrnst. *et* Heyn		22	Herrnstadt and Heyn, 1977

Results and discussion

Meiotic and mitotic chromosome numbers were determined for 33 species, belonging to 24 genera (Table 2; Figs. 1-36). These reports include the first counts for *Calyptrosciadium*, *Demavendia* and *Rhabdosciadium*, 21 species and one subspecies of the family.

Counts that confirm previous chromosome numbers

The meiotic chromosome number of n=11 for the endemic *Azilia eryngioides* confirmed the only previous determination (Lamond, 1990).

Our two new determinations of the chromosome number in *Bupleurum exaltatum* from two different ostans of Central Iran confirmed the data by Küpfer (1982) based on Iranian material, also. Generally, *B. exaltatum* demonstrated, however, considerable dysploid variability with n=6, 7, 8 and 9. These different counts have not been localized or correlated to certain geographical sites. A cytotype of n=6 in *B. exaltatum* was not found in Iran but in Uzbekistan, Tadzhikistan, Pakistan and Turkey.

Chromosome numbers were determined at least 18 times for *Torilis leptophylla*. All results characterized the species as having x=6, and mainly as diploid, with two exceptions, when the species appeared to be tetraploid with the same basic number (Silvestre, 1978, 1986). Our determination (2n=12) firstly for Iranian plants, corresponded to the most usual count within the species.

Cervaria cervariifolia (=*Peucedanum cervariifolium* C.A. Mey.) in Alborz Mts. had n=11, that corresponded to earlier determination in Talysh (Azerbaidzhan) and Turkmenistan (Vasil'eva *et al.*, 1981a, b; Solovieva *et al.*, 1985).

We made the second determination of chromosome count of n=8 in *Eryngium thyrsoideum*, that confirmed the data in the Iranian material by Perdigo i Ariso (1981).

We confirmed three previous records for *Heracleum persicum*, including one based on Iranian native material (Aryavand, 1983).

In *Heptaptera anisoptera* our new determination (2n=22) corresponded to the counts, twice recorded for the species from Israel (Herrnstadt and Heyn, 1971; Pimenov and Vasil'eva, 1983), as well as to the chromosome numbers of two other species of the genus.

In *Bunium elegans* our determination confirmed the chromosome number (2n=18), previously obtained for material from Armenia (Vasil'eva *et al.*, 1985). In this genus wide interspecies dysploid variability of counts is observed, but each species has, as a rule, constant number.

Table 2. The species and chromosome numbers of the Umbelliferae studied here

Species	Locality	n	2n	Fig.
Astrodaucus persicus (Boiss.) Drude*	Tehran, Alborz Mts, S slope, Tochal Mt. 35°41′N, 51°24′E, alt. 1,990 m. 31.05.2001, N 20.	10		1
	Tehran, Alborz Mts, S slope, valley of Karaj River, road Karaj-Chalus, above Khusan-kala. 35°57′N, 51°18′E, alt. 1,600 m. 29.06. 2001, s/n		20	2
Azilia eryngioides (Pau) Hedge *et* Lamond	Lorestan, between Shoulabad and Sefid Dascht, S slope of Ochtoran Mt. 33°12′N, 49°07′E, alt. 2,080 m. 19.06.2001, N 492.	11		3
Bunium elegans (Fenzl) Freyn	Tehran, Alborz Mts, S slope, valley of Karaj River, road Karaj-Chalus, near Hassanakdar. 36°01′N, 51°18′E, alt. 2,060 m. 29.06.2001, N 540		18	4
Bupleurum exaltatum M. Bieb.	Tehran, Alborz Mts, S slope, Tochal Mt. 35°41′N, 51°24′E, alt. 2,300 m. 31.05.2001, N 36.	6		5
	Arak, Negri-Kamar pass between Tafresh and Arak. 34°38′N, 49°57′ E, alt. 2,450 m. 17.06.2001, N 394	6		
B. kurdicum Boiss.*	Lorestan, road Khorram Abad-Nur Abad, between Aleshter and Nur Abad, Kamraza River. 33°42′N, 48°21′E, alt. 1,660 m. 18.06.2001, N 443.	8+1B		6, 7
Calyptrosciadium bungei (Boiss.) Pimenov**	Khorasan, near Mashhad, Kuh-e Bilalud Mts., above village of Zoshg. 36°18′N, 59°09′E, alt. 2,350 m. 23.06.2001, N 505.	11		8
Cervaria cervariifolia (C.A. Mey.) Pimenov	Tehran, Alborz Mts., S slope, E of Tehran, between Reine and Pulur, subalpine meadows on the slope of Damavand Mt. 35°52′N, 52°06′E, alt. 2,600 m. 01.06.2001, N 89.	11		9
Chaerophyllum macropodum Boiss.*	Lorestan, Ochtoran Mt., W slope, between Dorood and Soravend. 33°28′N, 49°04′E, alt. 1,600 m. 19.06.2001, s/n.		22	10
Demavendia pastinacifolia (Boiss.) Pimenov**	Tehran, Alborz Mts, S slope, Tochal Mt. 35°41′N, 51°24′E, alt. 2,100 m. 31.05.2001, N 23.	11		11
Echinophora platyloba DC.*	Arak, 30 km W from junction of Save-Esfahan road and road to Tafresh. 34°36′N, 50°20′E, alt. 1,500 m. 17.06.2001, N 383.	11		12
Eryngium bungei Boiss.*	Arak, E of Arak. 34°07′N, 49°58′E, alt. 1,620 m. 20.06.2001, N 493.	8		13
E. thyrsoideum Boiss.	Lorestan, between Nojan and Keshwar, Quercus brantii forest. 33°17′ N, 48°29′E, alt. 1,900 m. 18.06.2001, N 422.	8		14
Ferula flabelliloba Rech.f *et* Aellen*	Khorasan, Near Mashhad, Kuh-e Bilalud Mts. above village of Zoshg. 36°18′N, 59°09′E, alt. 2,010 m. 23.06.2001, N 500.		22	15
F. haussknechtii H.Wolff *ex* Rech.f.*	Boyerahmad va Kohgiluye, between Jasuj and Sapidan on the road to Shiraz. 30°29′N, 51°42′E, alt. 2,300 m. 07.06.2001, N 262.	11		16
Ferulago carduchorum Boiss. *et* Hausskn. *ex* Boiss.*	Boyerahmad va Kohgiluye, Zagros Mts., S slope of Kuh-e Daena, above Sisaht. 30°52′N, 51°30′E, alt. 2,660 m. 07.06.2001, N 215.	11		17
Heptaptera anisoptera (DC.) Tutin	Lorestan, between Nojan and Keshwar, Quercus brantii forest. 33°17′ N, 48°29′E, alt. 1,900 m. 18.06.2001, N 438.		22	18
Heracleum persicum Desf. *ex* Fisch.	Khorasan, Near Mashhad, Kuh-e Bilalud Mts. above village of Zoshg. 36°18′N, 59°09′E, alt. 2,010 m. 23.06.2001, N 497.		22	19
Johreniopsis scoparia (Boiss.) Pimenov*	Arak, Zalion pass between Arak and Borujert. 33°53′N, 49°00′E, alt. 2,100 m. 17.06.2001, N 406.	11		20

Table 2. continued

Species	Locality	n	2n	Fig.
Leiotulus secacul (Mill.) *et* Ostroumova subsp. *aucheri* (Boiss.) Pimenov *et* Ostroumova*	Qazvin, road Takestan-Hamadan, near Obe-Garm, valley of Charrud River. 35°52′N, 49°14′E, alt. 1,550 m. 13.06.2001, N 288.		44	21
Leutea petiolaris (DC.) Pimenov	Tehran, Alborz Mts., S slope, near Dizin. 36°02′N, 51°25′E, alt. 3,060 m. 29.06.2001, N 556.	11		22
Pimpinella boissieri M. Hiroe*	Lorestan, road Khorram Abad-Nur Abad, between Aleshter and Nur Abad, Kamraza River. 33°42′N, 48°21′E, alt. 1,660 m. 18.06.2001, N 447.	10		23
P. deverroides (Boiss.) Boiss.*	Esfahan, vicinity of Esfahan, Kuh-e Safeh Mt., stony slopes. 32°35′N, 51°38′E, alt. 2,300 m. 05.06.2001, N 149.	22		24
P. oliverioides Boiss. *et* Hausskn. *ex* Boiss.*	Lorestan, Ochtoran Mt., W slope, between Dorood and Soravend. 33°28′N, 49°04′E, alt. 1,600 m. 19.06.2001, N 458.	10		25
P. puberula (DC.) Boiss.	Tehran, Alborz Mts., S slope, 20 km E of Tehran, between Rudhan and Djedjirud, steppe. 35°44′N, 51°45′E, alt. 1,900 m. 01.06.2001, N 105.	10		26
P. tragioides Boiss.*	Boyerahmad va Kohgiluye, Zagros Mts., S slope of Kuh-e Daena, above Sisaht. 30°52′N, 51°30′E, alt. 2,660 m. 07.06.2001, N 214.	10		27
P. tragium Vill.	Tehran, Alborz Mts., S slope, E of Tehran, between Rudhan and Akban, Imam Zade-Chashim pass, stony slope. 35°46′N, 51°57′E, alt. 2,400 m. 01.06.2001, N 68.	10		28
	Boyerahmad va Kohgiluye, Zagros Mts., S slope of Kuh-e Daena, above Sisaht. 30°52′N, 51°30′E, alt. 3,100 m. 07.06.2001, N 241.	20		29
Pseudotrachydium kotschyi (Boiss.) Pimenov *et* Kljuykov*	Hamadan, S of Hamadan, Alvand Mts., N slope. 34°42′N, 48°26′E, alt. 2,700–2,800 m. 14.06.2001, N 341.	9+1B		30
Pycnocycla spinosa Decne. *ex* Boiss.*	Tehran, between Tehran and Ghom, 115 km N of Ghom, S of Hassan Abad, Kuh-e Arab Mt. 35°25′N, 51°18′E, alt. 1,400 m. 04.06.2001, N 107.	11		31
Rhabdosciadium aucheri Boiss.**	Boyerahmad va Kohgiluye, Zagros Mts., S slope of Kuh-e Daena, above Sisaht. 30°52′N, 51°30′E, alt 2,900 m. 07.06.2001, N 246.	11		32
Semenovia dichotoma (Boiss.) Manden.*	Boyerahmad va Kohgiluye, Zagros Mts., S slope of Kuh-e Daena, above Sisaht. 30°52′N, 51°30′E, alt. 3,100 m. 07.06.2001, N 236.	11		33
Seseli olivieri Boiss.*	Tehran, Alborz Mts, S slope, Tochal Mt., rock fissures. 35°41′N, 51°24′E, alt. 2,400 m. 31.05.2001, N 48.	11		34
	Tehran, Alborz Mts, S slope, near Shemchak. 35°59′N, 51°28′E, alt. 2,410 m. 29.06.2001, N 565.	11		
Torilis leptophylla (L.) Rchb. f.	Chaharmahal va Bakhteyary, Zagros Mts., between Shahr-e Kord and Arbil, Tenge-haradji. 32°07′N, 50°20′E, alt. 2,460 m. 05.06.2001, N 172.		12	35
Zeravschania membranacea (Boiss.) Pimenov*	Qazvin, road Takestan–Hamadan, between Nechavend and Obe-Garm, valley of Charrud River. 35°50′N, 49°29′E, alt. 1,400 m. 13.06.2001, N 275.	11		36

*—first determination for species or subspecies **—first determination for genus

The second determination of the chromosome number of n=11 for *Leutea petiolaris* was the same as the first one (Vasil'eva *et al.*, 1981b), made for Turkmenian plants [under the synonym *Ferula turkomanica* (Schischk.) Pimenov].

In *Pimpinella* we confirmed the chromosome number of n=10 for *P. puberula*, but only partly. For the species the chromosome number of 2n=20 was previously determined (Vasil'eva *et al.*, 1981b) for the plants from Turkmenistan, whereas Jurtzeva (1988) found the chromosome number of 2n=18 in the same region. *Pimpinella tragium* was very variable in morphology and chromosome number. Not only the chromosome number of n=10 (or 2n=20) (Garbari *et al.*, 1980; Strid and Franzen, 1981; Montmollin, 1984; Jurtzeva, 1988) but also the chromosome numbers of 2n=18 and 20 (Vasil'eva *et al.*, 1993), 2n=18 (Garde and Malheiros-Garde, 1949; Sz.-Borsos, 1970; Cardona and Contandriopoulos, 1980; Rostovtzeva, 1982), n=20 (Küpfer, 1982: in the Iranian material) and 2n=22 (Peev and Andreev, 1978) have been known for the species and its infraspecific taxa. We investigated two populations of the species determined different chromosome counts with the basic chromosome number of x=10 such as the diploid (n=10) in Alborz Mts. and tetraploid (n=20) in Zagros Mts. Lastly, our data corresponded to those by Kupfer, who studied the material in the adjacent region in Ostan of Bakhtiari.

We documented additional chromosome number for *Pseudotrachydium* (Kljuykov *et al.*) Pimenov and Kljuykov, recently separated taxonomically from *Aulacospermum* Ledeb. (Pimenov and Kljuykov, 2000a). Two species of the genus in Tadzhikistan and Turkmenistan studied (Vasil'eva and Pimenov, 1985; Vasil'eva *et al.*, 1991) showed the chromosome number of n=9 (2n=18). This chromosome number confirmed for *P. kotschyi* in Western Iran, and was recorded here for the first time.

First chromosome count for subspecies

We determined the chromosome number of *Leiotulus secacul* subsp. *aucheri* (*Malabaila aucheri* Boiss.) in Qazvin population was tetraploid (2n=44) reported here for the first time. Such a polyploid was rare case not only in the area of Iran, but also in connection with chromosome number variability in *L. secacul* type subspecies. There are four previous records for the species; two were diploid with the basic chromosome number of x=11. The chromosome number of 2n=22 was recorded in Turkey (Strid, 1987) and that of n=11 was recorded in Jordan (Al-Eisawi, 1987); one was tetraploid (n=22) with the same basic chromosome number of x=11 (Constance *et al.*, 1976) recorded in Israel; and the other one was diploid (n=10) with the basic chromosome number of x=10 (Shner *et al.*, 2004) recorded in Turkey.

First chromosome counts for species

Astrodaucus persicus with n=10 and 2n=20 documented here for the first time was a critical species and could be closely related to *A. orientalis* (Pimenov, 1987). The chromosome number of *A. persicus* was the same as that of *A. littoralis* and *A. orientalis*. Therefore, this determination confirmed the chromosome number typical to the genus.

The chromosome number of the annual weedy *Bupleurum kurdicum* was studied here for the first time; it was n=8+1B. This chromosome number was widely found throughout the annual members of *Bupleurum*.

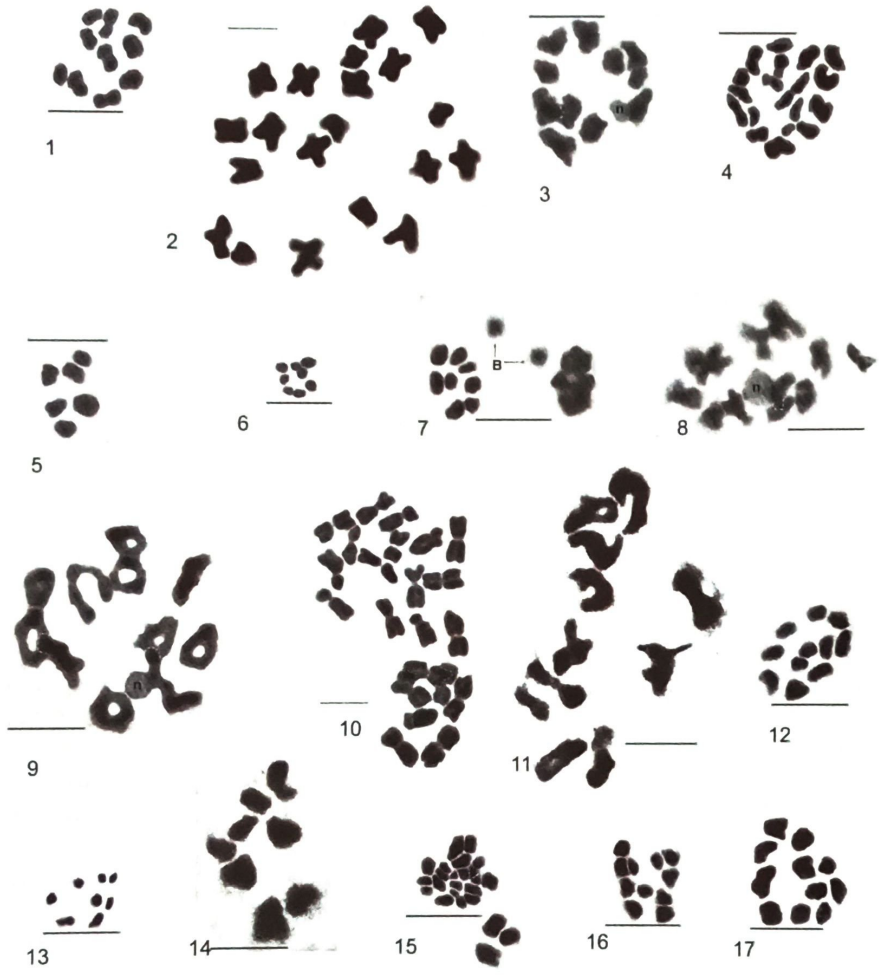
Chaerophyllum macropodum is one of the widely distributed species of the genus in Iran. This species showed the chromosome number of 2n=22 for the first time, which was common to that in 21 species of *Chaerophyllum* previously reported. The chromosomes of the species in the genus studied were commonly middle-sized.

Similar to the chromosomes of *Chaerophyllum*, those of *Ferula* showed more karyotypic uniformity and the same chromosome number of n=11. *Ferula flabelliloba* and *F. haussknechtii* as well as *Ferulago carduchorum* studied here showed the same phenomena described above.

Five species of *Semenovia* Regel *et* Herder, the tribe Tordylieae studied verified the previous counts of n=11 that might be diploid. The chromosome count of n=11 for *S. dichotoma* in Zagros Mts. was documented here for the first time.

Echinophora platyloba endemic to Iran was the forth karyologically investigated species in the genus. Similar to *E. sibthorpiana* Guss. in Turkey (Pimenov *et al.*, 1998; Shner *et al.*, 2004) and *E. tenuifolia* L. in Italy (Brullo *et al.*, 1991), *E. platyloba* had the chromosome number of n=11, while European *E. spinosa* L. showed the chromosome numbers of n=30 and 32 (Wanscher, 1933; Cauwet, 1968; Rashid, 1974). The present chromosome count suggested that the most probable basic chromosome number for the genus might be x=11. Among the members of *Pycnoclycla* Lindl., the tribe *Echinophoreae* centered in diversity to Iran and its adjacent arid countries, *P. aucherana* Decne. *ex* Boiss. and *P. bashgardiana* Mozaff. in Pakistan (Khatoon and Ali, 1993) showed commonly n=11. The present study documented that *P. spinosa* in Central Iran showed the chromosome number of n=11 for the first time. According to this chromosome number, the basic chromosome number might be x=11 that covered the whole part of the tribe.

Pimpinella deverroides locus classicus (Esfahan) showed the chromosome number of n=22, tetraploid. The chromosome number of n=22 was uncommon in

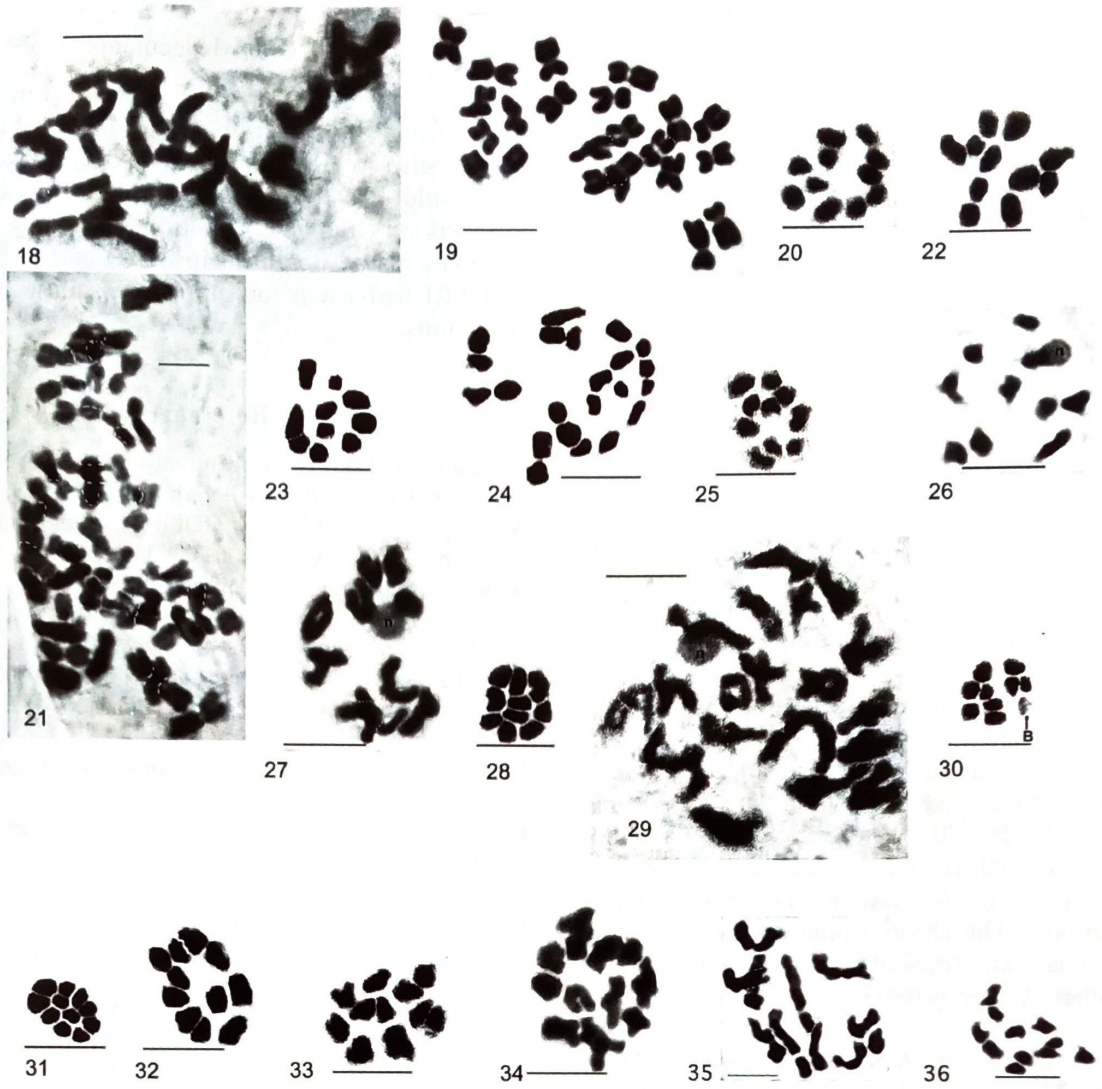


Figures 1-17. Chromosomes in Iranian species of the Umbelliferae: 1. *Astrodaucus persicus*, n=10, P2. 2. *Astrodaucus persicus*, 2n=20. 3. *Azilia eryngioides*, n=11, P1. 4. *Bunium elegans*, 2n=18. 5. *Bupleurum exaltatum*, n=5, P1. 6. *B. kurdicum*, n=8, A1. 7. *B. kurdicum*, n=8+1B, A1. 8. *Calyptrosciadium bungei*, n=11, P1. 9. *Cervaria cervariifolia*, n=11, P1. 10. *Chaerophyllum macropodum*, 2n=22. 11. *Demavendia pastinacifolia*, n=11, P1. 12. *Echinophora platyloba*, n=11, A1. 13. *Eryngium bungei*, n=8, A1. 14. *E. thyrsoideum*, n=11, P1. 15. *Ferula flabelliloba*, 2n=22. 16. *F. haussknechtii*, n=11, A2. 17. *Ferulago carduchorum*, n=11, P1. n=nucleolus. B=B-chromosome. P1=prophase I in meiosis. A1=anaphase I in meiosis. P2=prophase II in meiosis. A2=anaphase II in meiosis. Bar=10 μm.

the genus, excepting it was counted previously only in *P. favifolia* C. Norman in Malawi (Constance and Chuang, 1982). The plants collected in Lorestan, Iran, which were very similar to the syntypes (JE, LE) of *P. boissieri* M. Hiroe (=*Deverra dichotoma* Boiss. *et* Hausskn. *ex* Boiss.), which erroneously treated in "Flora Iranica" (Engstrand, 1987) as a synonym of *P. deverroides*. This collection showed the chromosome number of n=10, which was usual in number in the species of the genus studied. Differences in basic chromosome number and ploidy level from the other species were additional evidences of *P. boissieri* being different status. The plants collected in the slopes of Kuh-e Daena, Zagros Mts. were identified as "*P. deverroides*" by the manual of "Flora Iranica", which recorded the chromosome number of n=10. They were corresponded to the description and materials of *P. tragioides*, of which chromosome number was not counted. The chromosome number of n=10 was here documented for *P. oliverioides* for the first time. *Pimpinella kotschyana*, the close relative of *P. oliverioides*, had also the chromosome number of n=10 (Shner *et al.*, 2004).

Sixty-three species of *Seseli* have already shown their chromosome numbers. The present study of *S. olivieri* showed the chromosome number of n=11 that was corresponded to 47 other species of the genus. *Seseli olivieri* was previously treated as a member of *Eriocycla*, but was reduced to the sections of *Seseli* by Pimenov and Kljuykov (2000b).

Another documentation of chromosome number was



Figures 18-36. Chromosomes in Iranian species of the Umbelliferae: 18. *Heptaptera anisoptera*, 2n=22. 19. *Heracleum persicum*, 2n=22. 20. *Johreniopsis scoparia,* n=11, P2. 21. *Leiotulus secacul* subsp. *Aucheri*, 2n=44. 22. *Leutea petiolaris*, n=11, P1. 23. *Pimpinella boissieri*, n=10, P1. 24. *P. deverroides*, n=22, P1. 25. *P. oliverioides*, n=10, P1. 26. *P. puberula*, n=10, P1. 27. *P. tragioides*, n=11, P1. 28. *P. tragium*, n=10, A1. 29. *P. tragium*, n=20, P1. 30. *Pseudotrachydium kotschyi*, n=9+1B, A2. 31. *Pycnocycla spinosa*, n=11, A2. 32. *Rhabdosciadium aucheri*, n=11, A1. 33. *Semenovia dichotoma*, n=11, P1. 34. *Seseli olivieri*, n=11, P1. 35. *Torilis leptophylla*, 2n=12. 36. *Zeravschania membranacea*, n=11, P1. See Figures 1-17 for abbreviations of the explanation.

here made in *Zeravschania membranacea*, which was morphologically quite distinct from the other species of the genus; the chromosome number of this species was n=11 that was uniform in the genus.

Eryngium bungei displayed the chromosome number of n=8 for the first time and this chromosome number was common to the members of the genus studied. *Johreniopsis scoparia* showed the chromosome number of n=11 here for the first time, that was identical to the chromosome numbers of *J. seseloides.*

First chromosome numbers for genus

Three endemic or semi-endemic Iranian genera of the Umbelliferae were studied for the first time.

The first one was *Calyptrosciadium* Rech.f., which was taxonomically revised recently (Pimenov and Kljuykov, 2004). The common chromosome number of n=11 in the Apioideae was documented in the type species of the genus, *C. bungei* (=*C. polycladum* Rech.f.).

The second one was the monotypic *Demavendia* Pimenov taxonomically separated from *Peucedanum* (Pimenov, 1987). *Demavendia pastinacifolia* as well as its closely related *Zeravschania* Korovin (see below)

had the chromosome number of n=11.

The third one was *Rhabdosciadium* Boiss., a small genus consisted of 3-4 partly critical species, distributed in Iran and Turkey. *Rhabdosciadium aucheri* the most widely distributed to Iran had the chromosome number of n=11. The position of the genus in the Umbelliferae classification seemed now to be ambivalent. From morphological point of view (Drude, 1897-1898; Pimenov and Leonov, 1993) *Rhabdosciadium* belonged taxonomically to Scandiceae. The recent molecular-phylogenetic studies by Downie *et al.* (2000) excluded *Rhabdosciadium* from the tribe; in their molecular-cladistic tree the genus was placed in "*Aegopodium*"-clade. In this clade *Rhabdosciadium* was combined with *Grammosciadium* (another member of morphological *Scandiceae*) and *Carum*, *Falcaria*, *Aegokeras*, *Aegopodium* and some other distantly related taxa of *Apieae*. Therefore, this clade was very complex and hardly acceptable as taxon from morphological point of view. However, chromosome information would be less value in this discussion. The chromosome number of n=11 was the major number in the Scandiceae and showed the popularity in *Chaerophyllum*, *Osmorhiza* and some small genera, but not in *Grammosciadium* in which the three species investigated had the chromosome number of n=10 (2n=20) (Vinogradova, 1970; Shner *et al.*, 2004). In contrast, *Carum* showed the chromosome numbers of n=10 and n=11 approximately equally occurred. The chromosome number of x=11 was seen in *Falcaria*, *Aegokeras*, *Aegopodium* (partly) and many other Apieae genera.

Polyploids vs. diploids—predominance of diploid taxa

Among the 33 species of Iranian Umbelliferae investigated, the tetraploid *Pimpinella deverroides* and *Leiotulus secacul* subsp. *aucheri* were dubiously studied. *Pimpinella tragium* was secondly determined as another tetraploid taxon although its another population in Iran showed the diploid. Previously, some species of *Peucedanum* and *Prangos* had the documentation of the tetraploid and the hexaploid. Thus, the majority of the Iranian species of the family was diploids.

Concluding remarks

Among the chromosome numbers of 33 species in 24 genera of the Iranian Umbelliferae documented those of 21 species and one subspecies in three genera were recorded here for the first time. The species investigated were mostly diploids excepting two species were tetraploids. Infraspecific ploidy was seen in Iranian populations of *Pimpinella tragium*.

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