

# NEW OR RARE CHROMOSOME COUNTS OF SOME ANGIOSPERM SPECIES FROM IRAN II

S. MAHMOOD GHAFARI & K. KELICH

Ghaffari, S. M. & Kelich K. 2006 08 01: New or rare chromosome counts of some angiosperm species from Iran. *-Iran. Journ. Bot. 12 (1): 81-86*. Tehran.

Original meiotic chromosome counts are presented for 17 species in nine families of angiosperms from Iran. Chromosome counts for six species including: *Tanacetum polycephalum* subsp. *duderanum* (*Asteraceae*) (n=18), *Cardaria draba* subsp. *chalepensis* (*Brassicaceae*) (n=32), *Minuartia lineate* (*Caryophyllaceae*) (n=10), *Silene latifolia* subsp. *persica* (*Caryophyllaceae*) (n=12+1B), *Epilobium confusum* (*Onagraceae*) (n=10), and *Rumex scutatus* (*Polygonaceae*) (n=15) are new reports. Also, the diploid level of n=9 for *Nepeta racemosa* is reported here for the first time.

Seyed Mahmoud Ghaffari, Institute of Biochemistry and Biophysics, University of Tehran, P. O. Box 13145-1384, Tehran, Iran. E-mail: [ghaffari@ibb.ut.ac.ir](mailto:ghaffari@ibb.ut.ac.ir). -Kazem Kelich, Payame Noor University, Faculty of Science, Department of Biology, Tehran, Iran.

Key words. *Achillea*, *Cardaria*, *Centaurea*, *Cirsium*, *Crepis*, *Epilobium*, *Glaucium*, *Hypericum*, *Lotus*, *Minuartia*, *Nepeta*, *Rumex*, *Silene*, *Sisymbrium*, *Tanacetum*, *Thymus*, chromosome, Iran.

شمارش کروموزومی جدید یا نادر برای بعضی از گونه های نهانده ایران (۲)

سید محمود غفاری و کاظم کلیچ

مشاهدات کروموزومی برای ۱۷ گونه متعلق به ۹ خانواده ارائه شده است. شمارش کروموزومی برای ۶ گونه شامل:

*Tanacetum polycephalum* subsp. *duderanum* (*Asteraceae*) (n=18), *Cardaria draba* subsp. *chalepensis* (*Brassicaceae*) (n=32), *Minuartia lineate* (*Caryophyllaceae*) (n=10), *Silene latifolia* subsp. *persica* (*Caryophyllaceae*) (n=12+1B), *Epilobium confusum* (*Onagraceae*) (n=10), and *Rumex scutatus* (*Polygonaceae*) (n=15) برای اولین بار گزارش می شود. همچنین سطح دیپلوئیدی n=9 برای گونه *Nepeta*

*racemosa* نیز برای اولین بار ارائه شده است.

## INTRODUCTION

Chromosome numbers, karyotypes and analyses of meiotic pairing behavior at Metaphase I in species and hybrids can provide useful information for the assessment of taxonomic relationships (Stace, 2000). The purpose of this and others (Ghaffari & Sanei Chariat-Panahi 1985; Ghaffari, 1987a, 1987b, 1988, 2006) coming in the same series, is to give information concerning the chromosome counts of angiosperm taxa of the Iranian flora. The native flora of Iran comprises about 8000 angiosperm species. Chromosome counts on Iranian material have so far been carried out for about 1500 species, but in many cases only a single chromosome count has been studied. In the present study, chromosome counts for 17 species representing nine families are reported.

## MATERIAL AND METHODS

Floral buds of appropriate size were fixed in absolute ethanol: chloroform: propionic acid (6:3:2) for 24 hours, transferred to 70% alcohol and stored under refrigeration until analyzed. Anthers were squashed and stained in 2% acetocarmine. Chromosome counts were carried out from microsporocytes in various stages of meiosis. Chromosomes were studied under oil immersion on an Olympus microscope at a magnification of 320 x. All slides were made permanent by the ventian turpentine (Wilson, 1945). Voucher specimens are deposited in the Central Herbarium of Tehran University (TUH) or in the IRAN Herbarium.

## RESULTS AND DISCUSSION

### Asteraceae

*Achillea millefolium* L. subsp. *millefolium*

Tehran: Firoozkouh, Gaduk, Ghaffari 3484, n = 32.

Basic chromosome number for the *Achillea* genus is  $x=9$  (Ehrendorfer 1960). This taxon has polyploid series of  $2n=18, 27, 36, 54$  and  $72$ . Previous report for this subspecies was  $n=36 + 0-3B$  from Mazandaran (Kandavan Mt.) by Ghaffari (1999). Present count from the new locality was octaploid ( $2n=8x=72$ ) and showed 36 bivalents at diakinesis (Fig. 1). No B chromosome in this sample was observed.

*Centaurea depressa* L.

Kurdistan: E Sanandaj, Ghaffari 1584, n= 8.

Fifty species are recognized in the genus *Centaurea* from Iran, of which 31 species are endemic (Wagenitz, 1980). Previous report for *C. depressa* is  $n=8$  from Karaj (Mardabad) by Ghaffari (1989). Our count from new locality was diploid with eight bivalents at diakinesis (Fig. 2).

*Cirsium arvense* L.

Tehran: Chitgar park, Ghaffari 2684, n=17.

Meiosis in this species was regular and showed 17 bivalents at diakinesis (Fig. 3), which agrees with the previous report by Ghaffari (1999) from a different locality.

*Crepis sancta* L.

Tehran: Firoozkouh, Gaduk, Ghaffari 3584, n=5.

Flora of Iran posses 24 species of *Crepis*, 12 of which are endemics. *C. sancta* is a diploid species with five bivalents at first metaphase and Diakinesis (Fig. 4 and 5). Previous report for this taxon is  $n=5$  (Ghaffari & Sanei Chariat-Panahi 1985).

*Tanacetum polycephalum* Schulz Bip. subsp. *duderanum* (Boiss.) Podl.

Tehran: Dizin, Ghaffari 3384, n=18.

*T. polycephalum* has seven subspecies in Iran. The genus *Tanacetum* posses 4 ploidy levels (diploid with  $2n=2x=18$ ; tetraploid with  $2n=4x=36$ ; hexaploid with  $2n=6x=54$ ). Also, one case of hypernanoploid with  $2n=82$  is reported (Kroguleich, 1984). Our sample was tetraploid with gametic number of  $n=18$ . Eighteen bivalents at metaphase I was observed (Fig. 6). Pollen mother cells in anaphase I were also examined to confirm the metaphase chromosome counts. The bivalents segregated regularly, 18-18 separations at anaphase I. According to our knowledge, this is the first chromosome count for this subspecies.

### Brassicaceae

*Cardaria draba* (L.) Desy. subsp. *chalepensis* (L.) O. E. Schulz

Semnan: Shahmirzad, Ghaffari 3784, n=32.

According to literature, *Cardaria draba* has three ploidy levels: diploid ( $2n=2x=16$ ), tetraploid ( $2n=4x=32$ ) and octaploid with  $2n=8x=64$  (see Fedorov 1974). Our sample was octoploid and showed 32 bivalents at diakinesis (Fig. 7). According to our knowledge, this is the first chromosome count for this subspecies.

*Sisymbrium loeselii* L.

Semnan: Shahmirzad, Ghaffari 3984, n=7.

Previous report for this taxon is  $n=7$  (Aryavand 1978; Khatoon 1993), which agrees with the present count of  $n=7$ . Meiosis in this species was regular and showed 7 bivalents at first metaphase (Fig. 8).

### Caryophyllaceae

*Minuartia lineata* Bornm.

Semnan: Shahmirzad, Ghaffari 3884, n=10.

Flora of Iran has about 20 species of the genus *Minuartia*, of these 6 species are endemic. *M. lineata* is a common endemic species to Iran and Iraq. Meiosis in this taxon was regular and showed 10 bivalents at first metaphase (Fig. 9). This is the first chromosome count for this taxon. Previous counts indicated the wide range of chromosome numbers ( $2n=11, 12, 13, 14, 15, 22, 23, 24, 26, 28, 30, 35, 36, 46, 48, 56$ ) in the genus *Minuartia* (Fedorov 1974, Ornduff 1968-1969, Moore 1970-1977, Goldblatt 1981-1988, Goldblatt & Johnson 1990-2003).

*Silene latifolia* Poir. subsp. *persica* (Boiss. & Buhse) Melzh.

Tehran; Shemshak, Ghaffari 3184, n=12+1B.

*Silene latifolia* comprises of three subspecies in Iran including: *S. latifolia* subsp. *alba* with chromosome number of  $2n=24$  (Lövkvist & Hultgåvd 1999), *S. latifolia* subsp. *ericalcinea* (not examined cytologically) and *S. latifolia* subsp. *persica*, which is examined in the present paper. Meiosis in this subspecies was regular and showed 12 bivalents at metaphase I and diakinesis, occasionally in some cells one B chromosome were observed (Fig. 10). According to our data, this is the first chromosome count for this species.

### Clusiaceae

*Hypericum scabrum* L.

Tehran: Shemshak, Ghaffari 3284, n= 26.

Previous counts for this taxon are  $2n = 28$  by Raynaud (1980) from Iran (between Karaj and Chalus) and  $n =$

24 by Ghaffari (1988) from Tehran (Abali). Present count indicated 26 bivalents at diakinesis and metaphase I (Fig. 11). According to literature, aneuploidy and ploidy levels are common in the genus *Hypericum*.

### Fabaceae

*Lotus corniculatus* L.

Tehran: Shemshak, Ghaffari 4084, n=12.

Previous report for this taxon are  $2n=12$ , 24 and 36 (Goldblatt 1981-88). One case of hypertetraploidy ( $2n=28$ ) also reported by Dodes et. al. (1997). Our sample was tetraploid with  $n=32$  (Fig. 12), which is in agreement with the previous count from Iran (Karaj) by the author (Ghaffari 1987a). At this time, no diploid level is reported for this species from Iran.

*Vicia persica* Boiss.

Tehran: Shemshak, Ghaffari 4384, n=5.

The genus *Vicia* has a various range of chromosome numbers ( $2n=10, 12, 13, 14, 18, 21, 22, 24, 28$  and 42), but  $2n=12$  and 14 are more common than the others (Fedorov 1969, Ornduff 1968-1969, Moore 1970-1977, Goldblatt 1981-1988, Goldblatt & Johnson 1990-2003). Meiosis in *V. persica* was regular and showed 5 bivalents at first metaphase (Fig. 13), which agrees with the previous reports (Ghaffari 1987a, Rahiminejsd et al. 2000).

### Lamiaceae

*Nepeta racemosa* Lam.

Semnan: Shahmirzad, Ghaffari 4184, n=9.

Previous report for tetraploid level of this taxon is  $n=18$  (Aryavand 1975). Our sample was diploid and showed 9 bivalents at metaphase I and diakinesis (Fig. 14). According to our data, this is the first diploid count for this species.

*Thymus pubescens* Boiss.

Tehran: Dizin, Ghaffari 3084, n=28.

The genus *Thymus* contains species with  $2n=14, 24, 26, 28, 30, 42, 48, 50, 54, 56, 58$  and 60, of them  $2n=28$  and octoploid level of it ( $2n=8x=56$ ) are more common than the others. *T. pubescens* was tetraploid and showed 28 bivalents at diakinesis (Fig. 15). This is the first chromosome number report for this taxon.

### Onagaraceae

*Epilobium cofusum* Hausskn.

Tehran: Shemshak, Ghaffari 4484, n=10.

Meiosis in this species was regular and in metaphase I ten bivalents (mostly rod-shaped) were observed (Fig.

16). As far as we know, this is the first report for this species.

### Papaveraceae

*Glaucium fimbriigerum* Boiss.

Tehran: Firoozkuh, Gaduk, Ghaffari 4284, n=6.

Meiosis in this taxon was very regular and showed 6 bivalents at metaphase I (Fig. 17). Also 6-6 segregation at anaphase I were observed (Fig. 18). The result agrees with the only previous count for this species (Safonova 1993) and first report for flora of Iran.

### Polygonaceae

*Rumex scutatus* L.

Tehran: Shemshak, Ghaffari 3684, n=15.

The cytotaxonomy of the genus *Rumex* has been the matter of many studies. The genus contains species with  $2n=14, 15, 16, 18, 20, 24, 28, 30, 36, 40, 42, 49, 50, 54, 60, 70, 80, 90, 100, 120, 130, 140$  and 200 (Fedorov 1974, Ornduff 1968-1969, Moore 1970-1977, Goldblatt 1981-1988, Goldblatt & Johnson 1990-2003). Previous chromosome counts for *R. scutatus* are  $2n=20$  and 40 (Lessani & Chariat-Panahi 1979, Luque & Dia Lifante 1991). Meiosis in our sample was very regular and showed 15 bivalents at diakinesis and metaphase I (Fig. 19). Also monad segregation at anaphase II was 15-15-15-15 (Fig. 20). This is the new chromosome count for this taxon. The difference of the present count with the previous reports is questionable. It should be pointed out, that the variability in chromosome complements in some species of the genus *Rumex* are common (see Goldblatt & Johnson 2003).

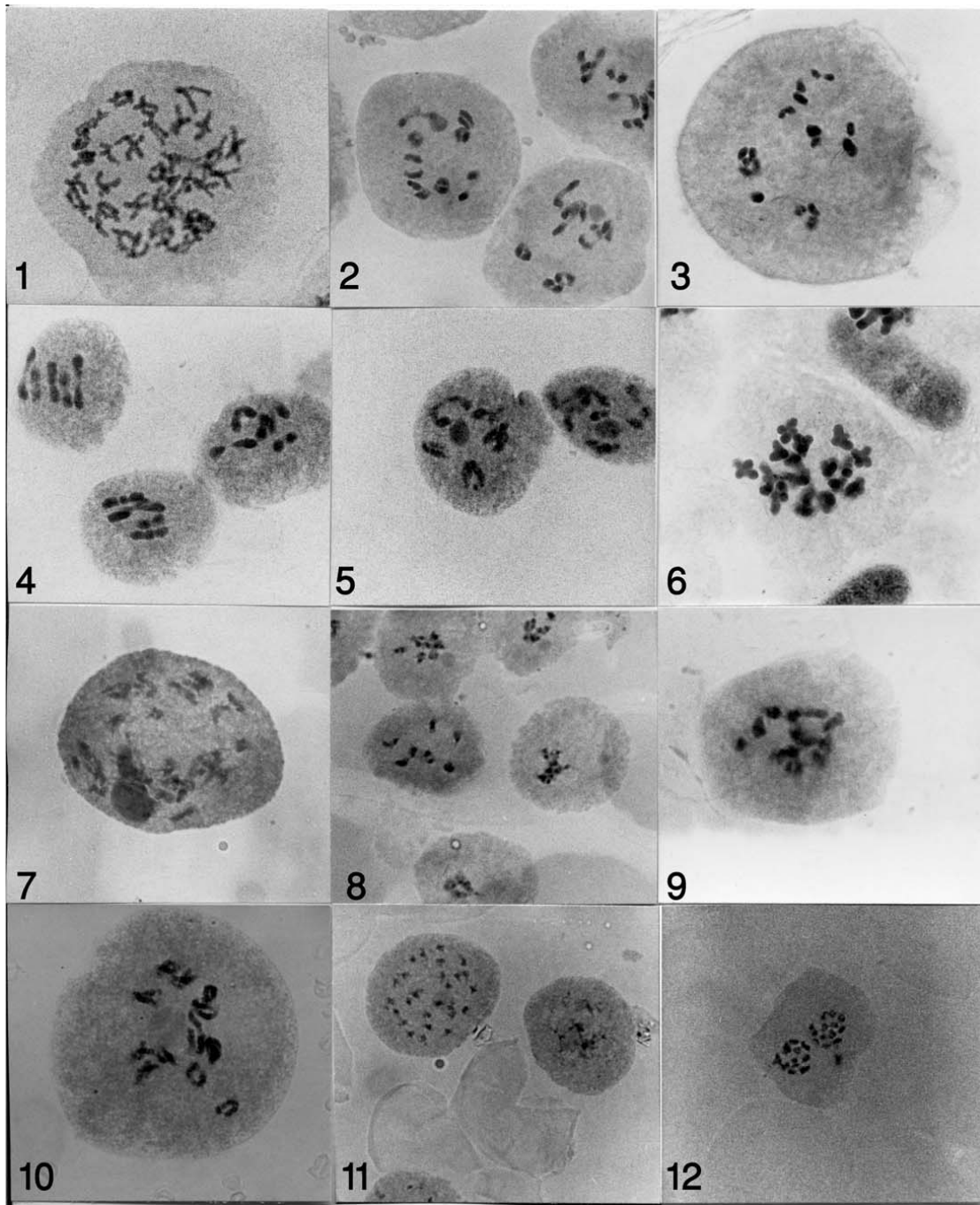
### ACKNOWLEDGEMENTS

This work was supported by grant (6401011/1/02) from Research Council of University of Tehran. I should like to thank Dr. M. Assadi and Dr. V. Mozaffarian for identification of some plants.

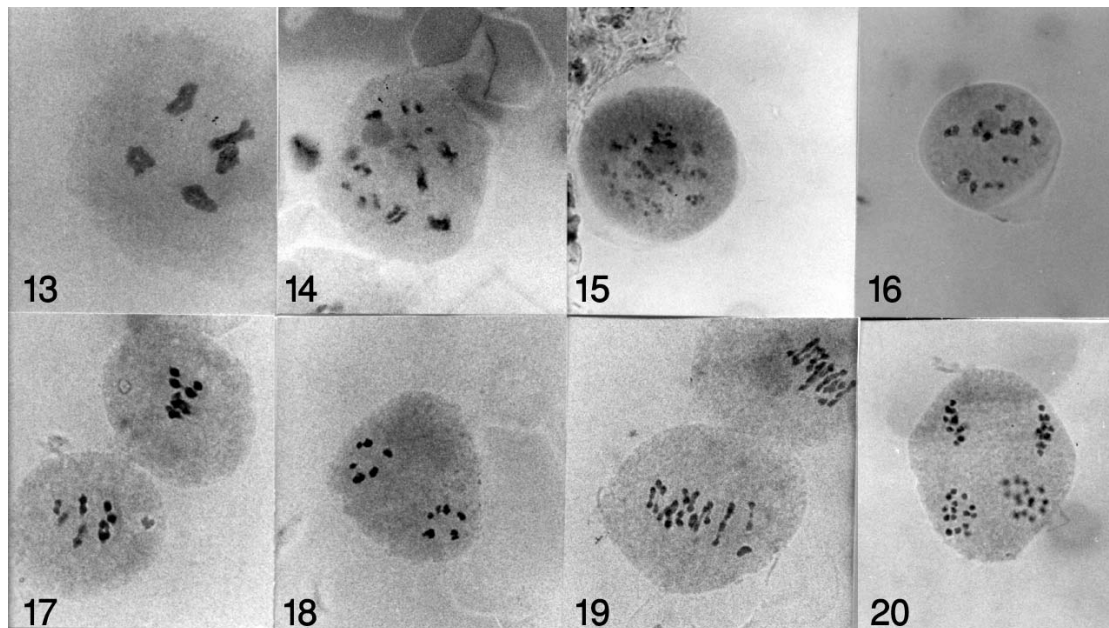
### REFERENCES

- Aryavand, A. 1975: Contribution a l'etude cytotaxonomique de quelques Angiospermes de l'Iran. -Bot. Notiser 128: 299-311.
- Aryavand, A. 1978: Contribution a l'etude cytotaxonomique des Cruciferes de l'Iran II. -Bull. Soc. Neuchat. Sci. Nat. 101: 95-106.
- Dodes, C., B. Hahu and W. Morawetz. 1997: Chromosomenzahlen zur Gefässpflazen - Flora österreicher. Linzer Biologische Beiträge 29(1): 5-43.
- Ehrendorfer, F. 1960: Akzessorische chromosomen bei Achillea: Auswirkungen auf das

- fortpflanzungssystem. Zahlen-Balance und Bedeutung für die Mikro-Evolution (Zur phylogenie der Gattung *Achillea*, VI).- Zeitschr. Induct.. – Abstam m.u. Vererbungslehre, 91, 3: 400-422.
- Fedorov, A. A. (ed.) 1974: Chromosome Numbers of Flowering Plants. -Koeltz, Königstein.
- Ghaffari, S.M. and Sanei-Chariat-Panahi, M. 1985: Chromosome counts of some Angiosperms from Iran. -Iran. Journ. Bot. 3 (1): 67-73.
- Ghaffari, S.M. 1987a: Chromosome counts of some Angiosperms from Iran II. -Iran. Journ. Bot. 3(2): 183-188.
- Ghaffari, S.M. 1987b: Chromosome studies in some flowering plants of Iran. -Rev. Cytol. Biol. Veget. Bot. 10: 3-8.
- Ghaffari, S.M. 1988: Etudes chromosomiques de quelques phanerogams d' Iran. -Bull. Soc. Neuchatel Sci. nat. III: 91-94.
- Ghaffari, S.M. 1989: Chromosome studies in Iranian Compositae. -Iran. Journ. Bot. 4 (2): 199-196.
- Ghaffari, S.M. 1999: Chromosome studies in the Iranian Asteraceae II. -Iran. Journ. Bot. 8 (1): 91-104.
- Ghaffari, S.M. 2006: New and rare chromosome counts of some Angiosperm species from Iran, -Iran. Journ. Bot. 11(2): 185-192.
- Goldblatt, P. 1981,1984,1985,1988: Index to plant chromosome numbers. 1975-1978, 1979-1981, 1982-1983, 1984-1985. -Monogr. Missouri Bot. Gard. 5, 8, 13, 23.
- Goldblatt, P. and Johnson D.E. 1990, 1991, 1994, 1996, 1998, 2000, 2003. Index to plant chromosome numbers. 1986-1987, 1988-1989, 1990-1991, 1992-1993, 1994-1995, 1996-1997, 1998-2000. -Monogr. Missouri Bot. Gard. 30, 40, 51, 58, 81, 94.
- Krogullevich, R.E. 1984: In R.E. Krogullevich & T. S. Rostovtseva. Khromosomnye Chisla Tsvetkovykh Rastenii I sibli Dal' nego Vostoka. Izdatel' stvo " Nauka", -Sibirskoe Otdelenie, Novosibirsk.
- Khatoon, S. & S.I. Ali 1993: Chromosome Atlas of the Angiosperms of Pakistan.- Department of Botany, Univesity of Karachi, Karachi.
- Lessani, H. & Sanei Chariat-Panahi. 1979: IOPB chromosome number reports LXV. -Taxon 28: 635-636.
- Lövkvist, B. & U.M. Hultgåvd. 1999: Chromosome numbers in south Swedish vascular plants. -Opera Botanica 137: 1-42.
- Luque, T. & Z. Dia Lifante. 1991: Chromosome numbers of plants collected during Iter Mediterraneo I in the SE of Spain.-Bocconeia 1: 303-364.
- Moore, R. J. (1970, 1971, 1972, 1973, 1974, 1977): Index to plant chromosome numbers for 1968, 1969, 1970, 1967—71, 1972, 1973-74. -Regnum Veg. 68, 77, 84, 90,91, 96.
- Ornduff, R. (1968, 1969): Index to plant chromosome numbers for 1966, 1967. -Regnum Veg. 55, 59.
- Rahiminejad, M. R., M. H. Ehtemam & A. Neishaboori. 2000: Cytotaxonomic studies of some Iranian *Vicia* species (Fabaceae). -J. Sci. I.R. Iran. 11(1): 1-5.
- Raynaud, C. 1980: Etude cytotaxonomique de quelques *Hypericum* d Iran. -Rev. Biol. Ecol. Mediterranee Tome VII no 1: 49-56.
- Safonova, I. N. 1993: A. Takhtajan (ed.), Numeri chromosomatum Magnoliophlorum Florae URSS, Moraceae- Zygophyllaceae. -Nauka, Petropli.
- Stace CA. 2000: Cytology and cytogenetics as a fundamental taxonomic resource for the 20(th) and 21(st) centuries Taxon 49 (3): 451-477.
- Wagenitz, G. 1980. *Centaurea* In: Rechinger, K.H., ed. Flora Iranica, 139a. -Graz.
- Wilson, G. B. 1945: The ventain turpentine mounting medium. -Stain Technology 20: 133-135.



Figs. 1–12. Microphotographs of meiotic division. Fig. 1. *Achillea millefolium* subsp. *millefolium*, diakinesis (n=32). Fig. 2. *Centaurea depressa*, diakinesis (n=8). Fig. 3. *Cirsium arvense*, metaphase I (n=17). Fig. 4, 5. *Crepis sancta*, metaphase I and diakinesis (n=5). Fig. 6. *Tanacetum polycephalum*, metaphase I (n=18). Fig. 7. *Cardaria draba*, diakinesis (n=32). Fig. 8. *Sisymbrium loeselii*, metaphase I (n=7). Fig. 9. *Minuartia lineate*, metaphase I (n=10). Fig. 10. *Silene latifolia*, diakinesis (n=12+1B). Fig. 11. *Hypericum scabrum*, diakinesis (n=26). Fig. 12. *Lotus corniculatus*, metaphase II (n=12).



Figs. 13–20. Microphotographs of meiotic divisions. Fig. 13. *Vicia persica*, metaphase I (n=5). Fig. 14. *Nepeta racemosa*, diakinesis (n=9). Fig. 15. *Thymus pubescens*, diakinesis (n=28). Fig. 16. *Epilobium cofusum*, diakinesis (n=10). Fig. 17 & 18. *Glaucium fimbriigerum*, metaphase I and anaphase I (n=6). Fig. 19 & 20. *Rumex scutatus*, metaphase I and anaphase II (n=15).