

CHROMOSME REPORTS FOR SOME PLANT SPECIES FROM IRAN

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Received: 15.12.2006. Accepted for publication: 12.03.2008.

Ghaffari, S. M. 2008 06 30: Chromosome records for some plant species from Iran. *-Iran. J. Bot. 14 (1): 39-46.* Tehran.

Original chromosome observations are presented for 34 species in 21 families of Angiosperms from Iran. Of these, the chromosome numbers, for 5 taxa including *Papver fugax* (*Papaveraceae*) $n=7$, *Ceratocephala testiculatus* (*Ranunculaceae*) $n=14$, *Ziziphus spina-christi* (*Rhamnaceae*) $2n=96$, *Rubia florida* (*Rubiaceae*) $n=22$, *Daphne angustifolia* (*Thymeleaceae*) $n=9$ are new observations. Also, chromosome counts for 15 taxa are new for the flora of Iran.

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اطلاعات کروموزومی برخی از گونه های گیاهی ایران

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مشاهدات کروموزومی برای ۳۴ گونه متعلق به ۲۱ خانواده از گیاهان گلدار ارائه شده است. شمارش کروموزومی برای ۵ گونه شامل *Ziziphus spina-christi* (*Rhamnaceae*) $2n=96$ ، *Ceratocephala testiculatus* (*Ranunculaceae*) $n=14$ ، *Papver fugax* (*Papaveraceae*) $n=7$ ، *Rubia florida* (*Rubiaceae*) $n=22$ و *Daphne angustifolia* (*Thymeleaceae*) $n=9$ برای نخستین بار ارائه شده است. همچنین گزارش کروموزومی ۱۵ گونه برای فلور ایران جدید می باشد.

Introduction

This paper is the seventh in a series dealing with cytological investigations in the Iranian flora (Ghaffari & Sanei Chariat-Panahi 1985, Ghaffari 1987a, 1987b, 1988, 2006a, 2006b). Genera are arranged in alphabetical order within families. For each taxon is given name and site of collection.

Materials and methods

Meiotic chromosomes were observed in pollen mother cells. 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. For somatic chromosome study, the seeds were germinated on moist filter paper in the laboratory (ca. 21°- 25°). The growing root tips of ca. 1.0- 1.5 cm long were cut and pretreated in 0.002 M 8-hydroxyquinoline (3 hours) at 20°C. After treatment, the root tips were fixed in the above fixative for 24 hours. The chromosomes were stained by the Feulgen method after hydrolysis in 1N Hcl for 10 minutes at 60°C. Root tips were then squashed in 2%

acetocarmine. Voucher specimens are deposited in the Central Herbarium of Tehran University (TUH).

Brassicaceae

Aethionema carneum (Banks & Soland) B. Fedtsch
Tehran: Taleghan, Samgh-abad, Ghaffari 7863.
Previous reports of $n=11$ (Maassoumi 1980), $n=11$ and $2n=22$ (Kupfer 1980) is in agreement with present count of $n=11$ (Fig. 1). Also, various count of $n=8$ is reported by Al-Shehbaz (1982). Different chromosome numbers are common in the species of the genus *Aethionema*. For example two counts of $n=12$ and $n=16$ are reported for *A. saxatile* (De Montmollin 1984, Humphries et al. 1978).

Alliaria petiolata (M.B.) Cavard & Grande
Tehran: Ab-ali. Ghaffari 8064.

Two chromosome races are reported for this taxon: diploid $2n=2x=42$ (Maassoumi 1980), and hexaploid with $2n=6x=42$ (Ancev & Goranova 1999). Also different counts of $2n=36$, 40, 42, and 43 is reported for this species (see Fedorov 1974). Our sample was hexaploid with 21 bivalents at diakinesis and 21-21 segregation at first anaphase (Figs. 2,3).

Capsella bursa-pastoris (L.) Medik.

Tehran: Karaj, Shahdasht, Ghaffari 2562.

Previous reports for this species are $2n=16$ and $2n=32$ (see Fedorov 1974). Tetraploid level of $n=16$ is reported by Aryavand (1977) from Iran. In the present study we found 8 bivalents at diakinesis (Fig. 4) which is diploid cytotype for the flora of Iran.

Crambe orientalis L.

Tehran: Chitgar park, Ghaffari 5864.

Previous reports of $n=15$ (Aryavand 1978, Maassoumi 1980) are in agreement with the present count of $n=15$.

Erysimum repandum L.

Tehran: Karaj, Shahdasht, Ghaffari 1162.

Maassoumi (1980) reported gametic number of $n=8$ for this species from Iran, which is in agreement with the present count of $n=8$ (Fig. 5). Also, different count of $n=7$ is reported by Aryavand (1978) from NW of Khoramabad.

Goldbachia laevigata (M.B.) DC.

Tehran: Karaj, Shahdasht, Ghaffari 1162.

Chromosome count in pollen mother cells showed 14-14 segregation at anaphase I (Fig. 6), which agrees with the previous reports (Khatoon & Ali 1993; Maassoumi 1980).

Matthiola ovatifolia Boiss.

Tehran: N. Tehran, Ghaffari 6664.

Meiosis in this taxon was regular and showed 6 bivalents at metaphase I (Fig. 7), which agrees with the previous report (Maassoumi 1980). Occasionally, in some cells quadrivalents at first metaphase and chromatid bridge at anaphase I were observed (Figs. 8, 9). Mitotic studies on meristematic cells of root tips confirmed our observation of meiotic studies, and showed chromosome complement of $2n=12$ (Fig. 10). To date, genus *Matthiola* has two basic numbers of $X=6$ and 7.

Chenopodiaceae*Cheopodium album* L.

Tehran: Karaj, Shahdasht, Ghaffari 10763.

According to our information, *C. album* has three ploidy levels: diploid ($2n=2x=18$), tetraploid ($2n=4x=36$) and hexaploid with $2n=6x=54$ (see Fedorov 1974). Our sample was hexaploid and showed 27 bivalents at first metaphase. Occasionally, in some cells multivalents were observed (Fig.11).

Salsola kali L.

Tehran: Karaj, Ghaffari 10362.

According to the previous reports, *S. kali* has three ploidy levels: diploid ($2n=2x=18$), tetraploid

($2n=4x=36$) and hexaploid ($2n=6x=54$) (Bhattacharya et al. 1971, Kockx-van Rom et al. 1982, Khatoon & Ali 1993). Our sample was tetraploid and showed 18 bivalents at diakinesis (Fig. 12). This count is first report for the flora of Iran.

Cistaceae*Helianthemum lippii* Pers.

Khuzistan: between Ahwaz and Hamidiyeh, Ghaffari 3964.

Previous report for this species is $2n=20$ (Podlech 1986) which is in agreement with the present count of $n=10$ (Fig. 13). This count is new for the flora of Iran.

Clusiaceae*Hypericum perforatum* L.

Tehran: Taleghan, Minavand, Ghaffari 9162.

Gametic chromosome number for this taxon was $n=16$, which is in agreement with the previous report of $2n=32$ (see Fedorov 1974). This count is new for the flora of Iran.

Convolvulaceae*Convolvulus arvensis* L.

Tehran: Karaj, Shahdasht. Ghaffari 4562.

C. arvensis has various cytotypes of $2n=24, 48, 50$ and 78 (see Fedorov 1974). In our sample 24 bivalents were observed at diakinesis (Fig. 14). This count is new for the flora of Iran.

Convolvulus cantabricus L.

Tehran: Karaj, Valian, Ghaffari 14463.

Previous count for this species is $2n=30$ (Lepper 1970) which is in agreement with the present count of $n=15$. This count is new for the flora of Iran.

Crassulaceae*Rosularia sempervivum* A. Berger var. *sempervivum*

Tehran: Sorkheh-hesar, Ghaffari 3766.

R. sempervivum possess two varieties in Iran: var. *sempervivum* and var. *glabrum* (Akhiani 2000). Eggli (1988) distinguished 7 subspecies in this taxon in the world. Two ploidy levels of $2n=2x=18$ and $2n=4x=36$ are reported for *R. sempervivum* (Eggli 1988). Our sample was diploid and showed 9 bivalents at metaphase I (Fig. 15). This is the first chromosome count for this taxon.

Euphorbiaceae*Euphorbia peplus* L.

Khuzistan: Dezful, Ghaffari 964.

Previous report for this species is $2n=16$ (Luque & Diaz Lifante 1991) which is in agreement with the

present count of $n=8$. This count is new for the flora of Iran.

Lamiaceae

Lamium amplexicaule L.

Khuzistan: Dezful, Ghaffari 1962.

Previous count of $2n=18$ was reported by Aryavand (1977) for this species from Iran (Khunsar), which is in agreement with the present count from the new locality (Fig. 16).

Salvia limbata C. A. Mey.

Tehran: Karaj, 5 Km towards Chalus, Ghaffari 10062.

Somatic chromosome count of $2n=22$ was reported by Afzal-Rafii (1981) from Iran, which is in agreement with the meiotic count of $n=11$ in this paper (Fig. 17).

Scutellaria pinnatifida Ham.

Tehran: Karaj, Valian.

Mazandaran: Siyah-bisheh, Ghaffari 15263.

Previous report for this taxon is $n=11$ by Aryavand (1977) from Iran (Rezaiyeh). Two collections of this taxon were studied from new localities and both have $n=11$ (Fig. 18). Also, 11-11 chromosome segregation at anaphase I was observed (Fig. 19).

Liliaceae

Eremurus inderiensis (Stev.) Boiss.

Semnan: between Semnan and Damghan, Ghaffari 8966.

The only one previous count for this species is $2n=14$ (see Fedorov 1974). Our sample was diploid and showed 7 bivalents at metaphase I (Fig. 20). This count is new for the flora of Iran.

Gagea reticulata Schult. & Schult. f.

Loristan: Pol-dokhtar, 10 Km towards Andimeshk, Ghaffari, 3086.

Our count was $2n=24$ (Fig. 21), which is in agreement with the previous report of $n=12$ by Koul & Wakhlu (1985) on pollen mother cells. This count is new for flora of Iran.

Orchidaceae

Dactylorhiza umbrosa (Kar. & Kir.) Nevski

Tehran: Karaj, Valian, Ghaffari 15463.

Previous report for this species is $n=20$ (Aryavand 1983) from Iran. Mitotic study on our sample showed $2n=40$ chromosomes at metaphase (Fig. 22).

Papaveraceae

Papaver fugax Poir

Hamadan: between Hamadan and Toycerkan, Ghaffari 10466.

Meiosis in this taxon was regular and showed gametic number of $n=7$ (Fig. 23). According to our data, this is the first chromosome count for this species.

Roemeria refracta DC.

Tehran: Taleghan, Samgh-abad, Ghaffari 7463.

Seven bivalents at diakinesis and 14 chromosomes at prophase of mitosis were observed (Fig. 24, 25). The only other count for this taxon ($2n=14$) is reported by Safonova (1991). This count is new for the flora of Iran.

Plantaginaceae

Plantago ovata Forssk.

Khuzestan: Ahwas, 20 km. towards Hamidiyeh. Ghaffari 4064.

Previous report of $n=4$ and $2n=8$ by Malallah and Brown (1999) is in agreement with the present count of $n=4$ in our sample. This count is new for the flora of Iran.

Plumbaginaceae

Psylliostachys picta (Willd.) Nevski

Khuzistan: Ahwaz, Ghaffari 267.

Previous report of $n=8$ (see Fedorov 1974) is in agreement with this result of $n=8$. The only other count ($2n=18$) for this taxon by Magulaev (1979), is questionable. This count is new for the flora of Iran.

Ranunculaceae

Ceratocephala testiculatus (Crantz) Roth

Tehran, Karaj, Shahdasht, Ghaffari 1163.

There is only one previous count of $2n=14$ for this species (Goepfert 1974). Our sample was tetraploid and showed 14 bivalents at diakinesis (Fig. 26). According to our literature review, this is the first chromosome count of tetraploid level for this taxon.

Ranunculus asiaticus L.

Khuzistan: Dezful, Ghaffari 1365

Gametic number of $n=8$ (Fig. 27) agrees with that of Tzanoudakis (1986), on the somatic number of $2n=16$ on this species. This count is new for the flora of Iran.

Resedaceae

Reseda lutea L.

Tehran: Karaj, Shahdasht, Ghaffari 10663.

According to literature, *R. lutea* has two ploidy levels: diploid ($2n=2x=24$) and tetraploid ($2n=4x=48$) (Lessani & Sanei Chariat-Panahi 1979, Gonzalez et al. 1980). Our sample was tetraploid with $n=24$.

Rhamnaceae

Ziziphus spina-christi (L.) Willd.

Khuzestan: Dezful, Ghaffari 2468.

Previous chromosome count on *Ziziphus* species indicate that this genus has various chromosome numbers of $2n=20, 24, 26, 40, 48, 60, 72,$ and 96 (Goldblatt 1981-1988; Goldblatt & Johnson 1990-2003). Somatic chromosome number in our sample showed $2n=96$ chromosomes (Fig. 28). According to our knowledge, this is the new chromosome count for this taxon. The only other count for the *Ziziphus spinachristi* var. *aucheri* (Boiss.) Qaiser & Nazim is $n=36$ from Pakistan by Khatoon and Ali (1993).

Rosaceae

Sangoisorba minor Scop.

Tehran: Karaj, Shahdasht, Ghaffari 1562.

Fourteen bivalents were observed at diakinesis in our sample (Fig. 29), which agrees with the previous somatic report of $2n=28$ (Love & Love 1982). This count is new for the flora of Iran.

Rubiaceae

Rubia florida Boiss.

Tehran: Sorkheh-hesar, Ghaffari 3966.

We found 22 bivalents at diakinesis in this taxon. All previous counts in species of the genus *Rubia* indicate the same basic number of $x=11$ (Goldblatt 1981-1988; Goldblatt & Johnson 1990-2003). According to our data, this is the first chromosome count for this species.

Scrophulariaceae

Verbascum sinuatum L.

Tehran: Karaj, Koshk-zar, Ghaffari 7262.

Previous report for this species is $2n=30$ (Demiriz 1980) which is in agreement with the present count of $n=15$ (Fig. 30). This count is new for the flora of Iran.

Thymeleaceae

Daphne angustifolia C. Koch.

Markazi: Arak, Tureh, Ghaffari 10966.

Meiosis in this species showed 9 bivalents at diakinesis (Fig. 31). Also, chromosome segregation at first anaphase was 9-9 (Fig. 32). According to our records, this is the first chromosome count for this species.

Urticaceae

Parietaria officinalis L.

Tehran: Karaj, 12 Km towards Chalus, Ghaffari 10263.

Previous count of $2n=14$ (Fedorov 1974) is the same as our present result of $n=7$ (Fig. 33). This is the new count for the flora of Iran.

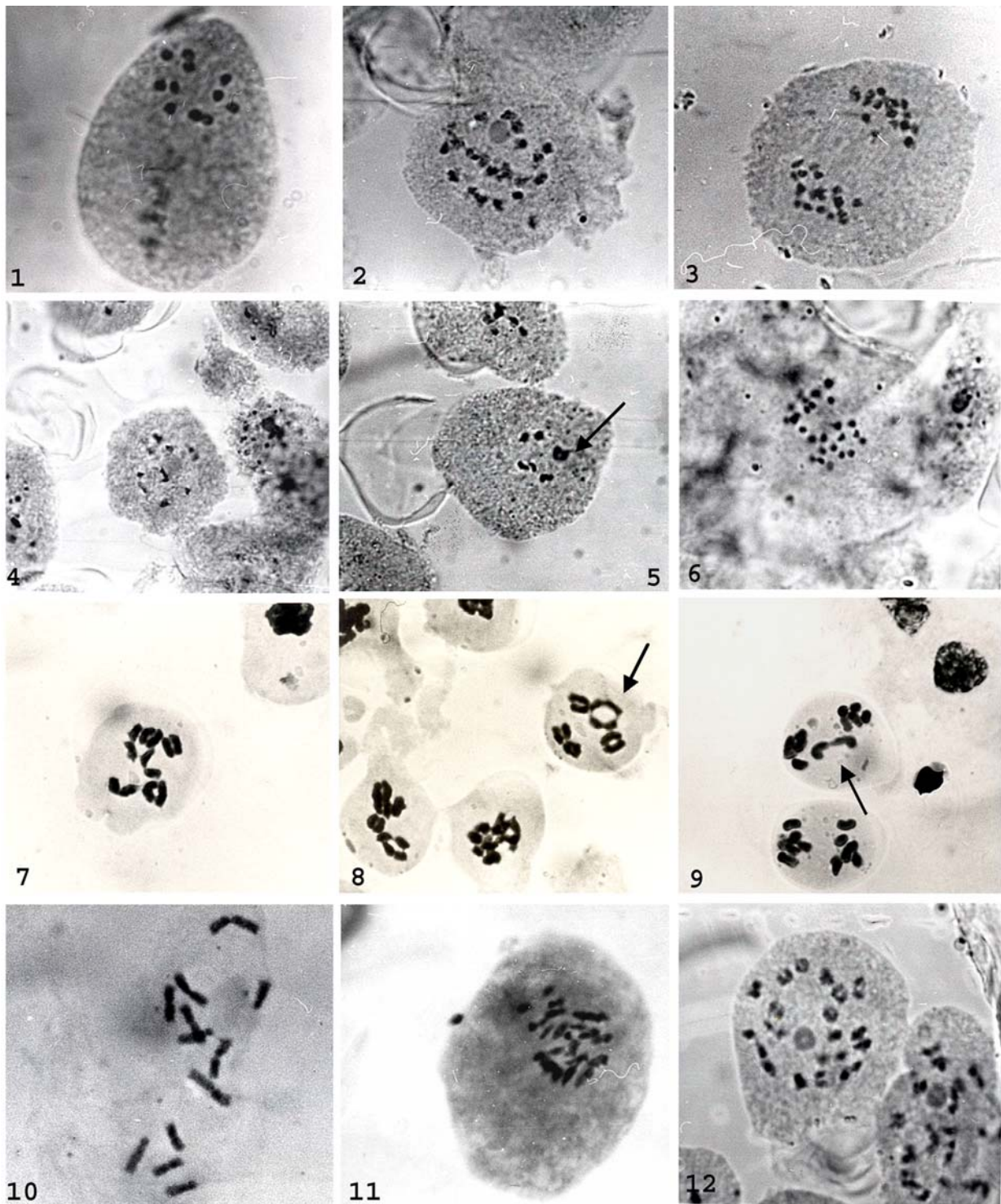
Acknowledgments

This work was supported by a grant (6401011/1/03) from the Research Council of the University of Tehran.

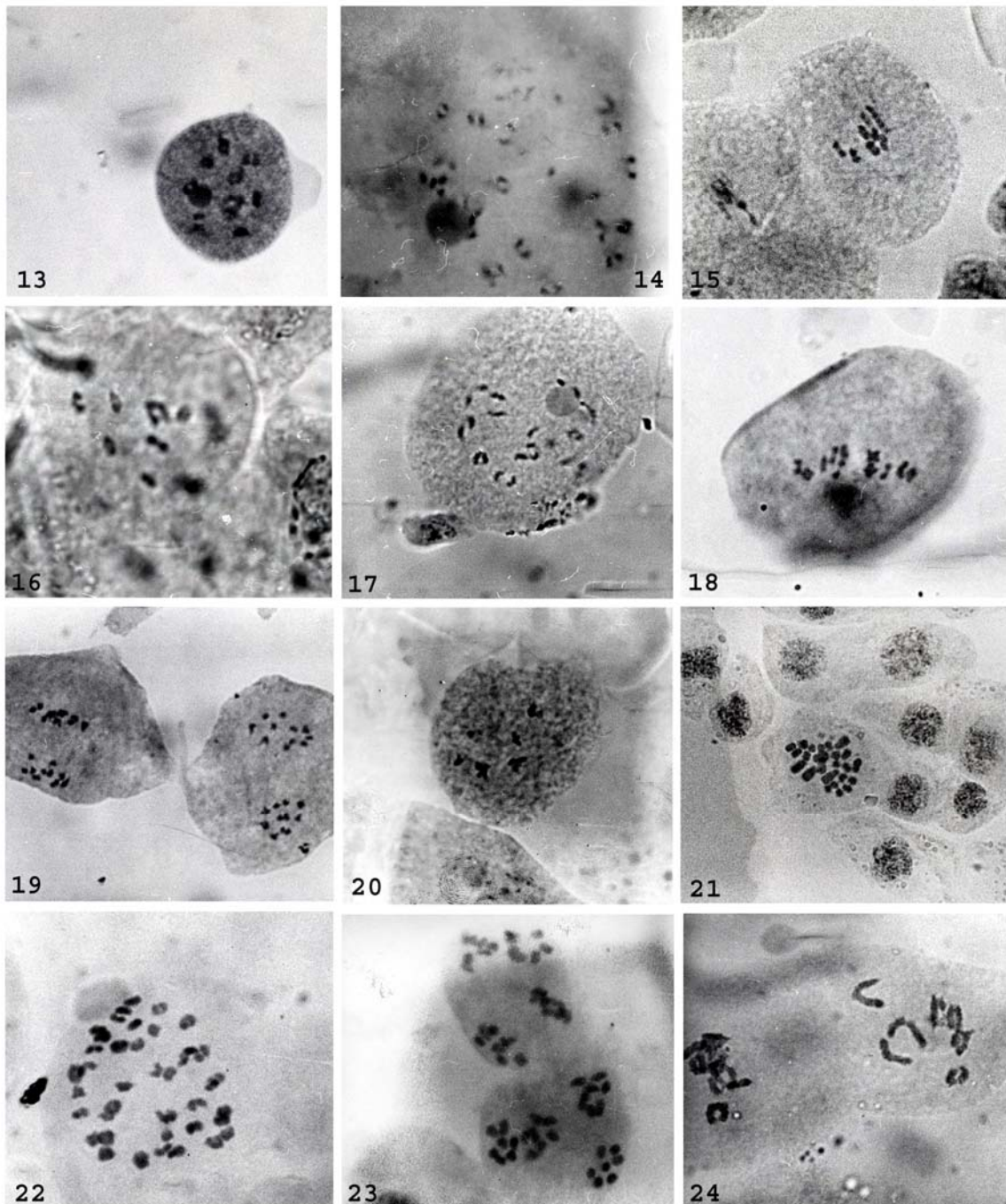
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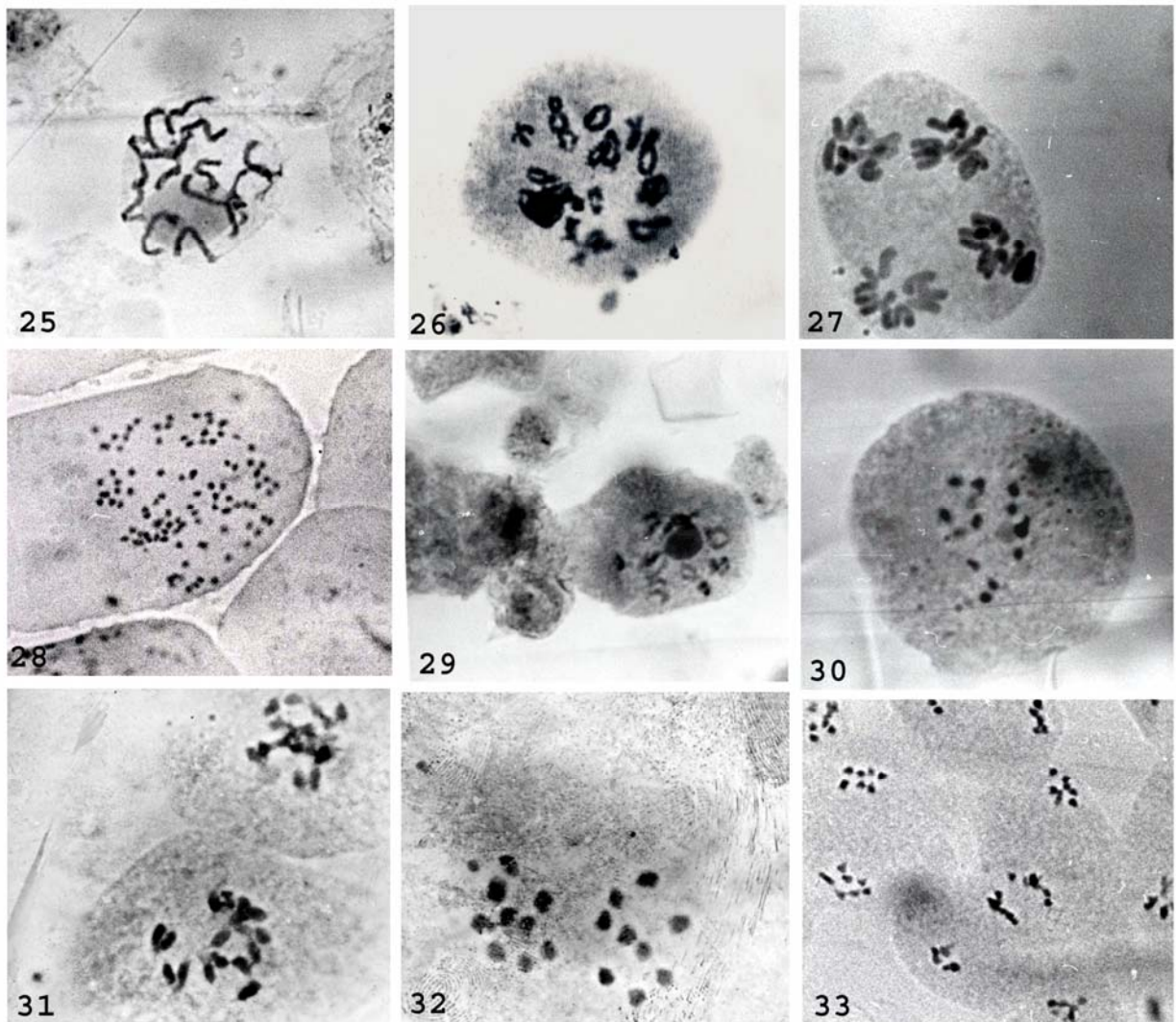
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Figures 1-12: 1. *Aethionema carneum*, metaphase II, $n=11$; 2-3. *Alliaria petiolata*. 2. Diakinesis, $n=21$. 3. Anaphase I, showing 21-21 chromosome segregation; 4. *Capsella bursa-pastoris*, diakinesis, $n=8$; 5. *Erysimum repandum*, metaphase I, $n=8$, showing hexavalent association (arrow); 6. *Goldbachia laevigata*, anaphase I, showing 14-14 segregation; 7-10. *Matthiola ovatifolia*. 7. Metaphase I, $n=6$. 8. Metaphase I, showing quaderivalent (arrow). 9. Anaphase I, showing chromatid bridge (arrow). 10. Metaphase of mitosis, $2n=12$.; 11. *Chenopodium album*, $n=18$; 12. *Salsola kali*, diakinesis, $n=18$. Initial magnification X340.



Figures 13-24: 13. *Helianthemum lippii*, diakinesis, $n=10$; 14. *Convolvulus arvensis*, diakinesis, $n=24$; 15. *Rosularia sempervivum* var. *sempervivum*, metaphase I, $n=9$; 16. *Lamium amplexicaule* metaphase I, $n=9$; 17. *Salvia limbata*, diakinesis, $n=11$; 18-19. *Scutellaria pinnatifida*. 18. Metaphase I, $n=11$. 19. Anaphase I, showing 11-11 chromosome segregation; 20. *Eremurus nderiensis*, metaphase I, $n=7$; 21. *Gagea reticulata*, metaphase of mitosis, $2n=24$; 22. *Dactylorhiza umbrosa*, metaphase of mitosis, $2n=40$; 23. *papaver fufax*, anaphase II, $n=7$; 24. *Roemeria refracta*, diakinesis, $n=7$. Initial magnification X340.



Figures 25-33: 25. *Roemetia refracta*, prophase of mitosis, $2n=14$; 26. *Ceratocephala testiculalus*, diakinesis, $n=14$; 27. *Ranunculus asiaticus*, anaphase II, $n=8$; 28. *Ziziphus spina-christi*, metaphase of mitosis, $2n=96$; 29. *Sangoisorba minor*, diakinesis, $n=14$; 30. *Verbascum sinuatum*, diakinesis, $n=15$; 31-32. *Daphne angustifolia*. 31. Diakinesis, $n=9$. 32. Anaphase I, showing 9-9 chromosome segregation; 33. *Parientaria officinalis*, anaphase I, $n=7$. Initial magnification X340.