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CHROMOSOME COUNTS OF EIGHT SPECIES FROM THE FLORA OF IRAN

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Abstract
Eight plant species belonging to the families Capparaceae, Plumbaginaceae, Primulaceae, Campanulaceae and Papaveraceae, collected from five provinces of the country, were examined to determine their chromosome numbers. The results showed that *Zeugandra iranica* had 2n=2x=14, *Cleome dolichostyla*, *C. iberica*, *C. quinquenervia*, and *C. viscosa* each had 2n=2x=20, *Papaver macrostomum* had 2n=2x=14, *Limonium thouini* had 2n=2x=12, *Androsace maxima* had 2n=4x=40 chromosomes. The chromosome numbers of *Zeugandra iranica* and *Cleome quinquenervia* are reported here for the first time worldwide. At the same time, those of *Cleome dolichostyla*, *Cleome viscosa*, *Papaver macrostomum*, and *Limonium thouini* are recorded for the first time in Iran.

Keywords: Cytogenetics; Campanulaceae; Capparaceae; Papaveraceae; Plumbaginaceae; Primulaceae

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شمارش کروموزومی هشت گونه از فلور ایران

هوشمند صفری: استادیار پژوهش، بخش تحقیقات جنگل و مرتع مرکز تحقیقات و آموزش کشاورزی و منابع طبیعی استان کرمانشاه، سازمان تحقیقات، آموزش و ترویج کشاورزی، کرمانشاه، ایران.

نسترن جلیلیان: دانشیار پژوهش، بخش تحقیقات جنگل و مرتع مرکز تحقیقات و آموزش کشاورزی و منابع طبیعی استان کرمانشاه، سازمان تحقیقات، آموزش و ترویج کشاورزی، کرمانشاه، ایران.

فرشته اسدی کرم: محقق بخش تحقیقات بیوتکنولوژی موسسه تحقیقات جنگلها و مراتع کشور، سازمان تحقیقات، آموزش و ترویج کشاورزی، تهران، ایران.

عادل جلیلی: استاد پژوهش بخش تحقیقات گیاهشناسی موسسه تحقیقات جنگلها و مراتع کشور، سازمان تحقیقات، آموزش و ترویج کشاورزی، تهران، ایران.

چکیده: هشت گونه گیاهی متعلق به خانوادههای Papaveraceae, Capparaceae, Campanulaceae، Plumbaginaceae و Primulaceae که از پنج استان کشور جمعآوری شده بودند، برای تعیین تعداد کروموزوم مورد بررسی قرار گرفتند. نتایج نشان داد که گونههای *Zeugandra iranica* دارای ۲n =۲x =۱۴، *Cleome dolichostyla*، *C. iberica*، *C. quinquenervia* و *C.*

Androsace viscosa هر کدام دارای ۲n=۲x=۲۰، *Papaver macrostomum* دارای ۲n=۲x=۱۴، *Limonium thouini* دارای ۲n=۲x=۱۲، *Androsace maxima* دارای ۲n=۴x=۴۰ کروموزوم بودند. اعداد کروموزومی گونه‌های *Zeugandra iranica* و *Cleome quinquenervia* برای اولین بار در جهان گزارش می‌شوند، همچنین اعداد کروموزومی گونه‌های *Cleome dolichostyla* ، *Cleome viscosa*، *Papaver macrostomum* و *Limonium thouini* برای اولین بار در ایران گزارش شدند.

INTRODUCTION

Chromosome number is the most commonly used karyotypic feature in cytotaxonomic analyses (Jalilian & al., 2023). Chromosomal index includes the number, size, and shape of chromosomes of a species in the metaphase of cell division. It is used to investigate phylogenetic relationships between species, the occurrence of polyploidy, and the selection of suitable species for hybridization in plant breeding. A few studies, particularly chromosome counts of native plant taxa, have been conducted in Iran (Ghahremaninejad & al. 2013; Ghaffari 2020). The present study is part of a national research initiative aimed at compiling a comprehensive chromosome inventory of the Iranian flora. Accordingly, the chromosome numbers of eight species from five plant families were examined, with two species reported worldwide for the first time.

MATERIALS AND METHODS

Seeds were disinfected with 20% sodium hypochlorite solution and cultivated on filter paper in a Petri dish under sterile conditions. Then, the seeds were germinated at room temperature, and rootlets 0.5 to 1 cm long were used in the study. To prepare metaphase cells, pretreatment (4 hours at 4°C with 0.5% α-bromo naphthalene solution), fixation (with Levitsky's solution for 16 hours at 4°C), hydrolysis (with 1 normal NaOH at 60°C for 6 minutes), and staining with hematoxylin were performed. After preparing slides from the root meristem region, images of metaphase cells (at least 5 cells) were prepared using an image analysis system. The voucher specimens are deposited in the herbaria of the mentioned provinces and the National Natural Resources Gene Bank of Iran.

RESULTS AND DISCUSSION

The findings of this study showed that the use of α-bromo naphthalene pretreatment and fixation with Levitsky's solution was appropriate for the species under study, and the use of a basic solution for hydrolysis and staining with hematoxylin in these species showed clear chromosomes. The chromosome numbers for the 8 plant species belonging to the five families studied are as follows:

Campanulaceae

Zeugandra iranica P.H. Davis

Specimen examined: Iran, Kermanshah Province, Gahvareh, Totshami, 1500m, Jalilian, 269, RANK, Gene bank code: 46670. The studied species was diploid, with a chromosome number of 2n=2x=14 (Fig. 1A). This species is native to Iran, and this is the first report of its chromosome number in the world.

Capparaceae

Cleome dolichostyla Jafri

Specimen examined: Iran, Hormozgan province, Bandar Abbas, Gav Bandi, 20m, Zaefi & Bahmanzadeh, 574, Gene bank code: 45821. The number of 2n=2x=20 chromosomes was observed in the studied species (Fig. 1B). The chromosome number obtained was consistent with the previous record from Pakistan (Khatoon and Ali, 1993). The distribution of this species has been reported in Afghanistan, Pakistan, and the Gulf States in addition to Iran, and this is the first chromosome report of this species in Iran.

Cleome iberica DC.

Iran, Khuzestan Province, Andica, Shimbar, 800m, Dinarvand, 8994, Genebank code: 46506. The chromosome number of this species was 2n=2x=20 (Fig. 1C), which was consistent with other previous reports from Iran (Ghaffari, 2006; Aryavand, 1983). This species is not native to Iran and is distributed in parts of Central Asia.

Cleome quinquenervia DC.

Specimen examined: Iran, Hormozgan province, Rudan, 160m, Soltanipour, 39161, Genebank code: 47041. No previous chromosome report has been available for this species, and this study provides the first report in the world. The results showed that the species has 20 chromosomes, indicating that it is a diploid species with a chromosome number of 2n=2x=20 (Fig. 1D). This species is not native to Iran and is distributed in parts of Central Asia.

***Cleome viscosa* L.**

Specimen examined: Iran, Khuzestan Province, Dezful, 150m, Hassounizadeh, 2100, Genbank code 46526. This species is an annual, sticky plant with a strong, penetrating odor and is covered with simple glandular hairs. It grows to a height of about 30–90 cm and is branched (Mali, 2010). The chromosome number of this species was 2n=2x=20 (Fig. 1E), which is consistent with previous reports from Pakistan (Khatoon and Ali, 1993) and India (Subramanian and Susheela, 1988). The species has a wide distribution across Asia and Africa, and this study presents the first chromosomal report of it from Iran.

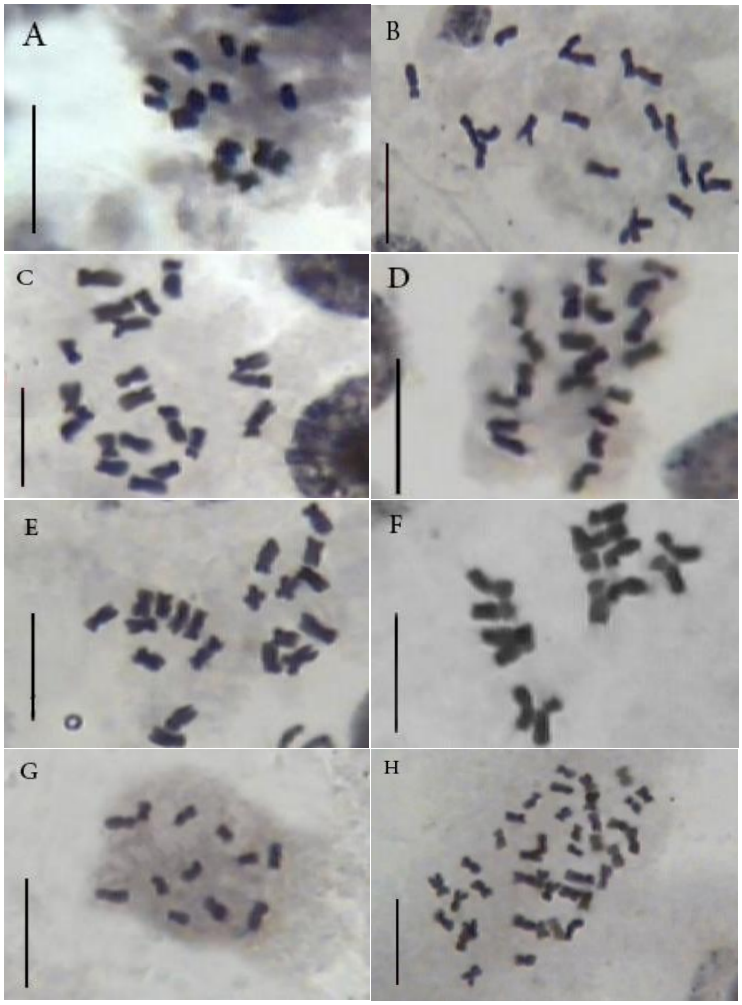

Fig. 1. Cytotypes of the eight studied species. A, *Zeugandra iranica*; B, *Cleome dolichostyla*; C, *Cleome iberica*; D, *Cleome quinquenervia*; E, *Cleome viscosa*; F, *Papaver macrostomum*; G, *Limonium thouini*; H, *Androsace maxima*. Scale bars for all=10µ.

Papaveraceae

Papaver macrostomum Boiss. & A. Huet

Specimen examined: Iran, Bushehr Province, Tangestan, Ahram, 65m, Gholamian, 408, Genbank code 46010. This species is an annual herbaceous plant that grows wild in different regions of Iran (Sharifnia & al. 2010). The chromosome number of this species is 2n=2x=14 (Fig. 1F), which is consistent with other reports from Kashmir (Koul and Gohil, 1973) and Turkey (Philipson & al., 1982). This species is native to Asia, and this is the first chromosomal report from Iran.

Plumbaginaceae

Limonium thouini (Viv.) Kuntze.

Specimen examined: Iran, Bushehr Province, Kangan, 20m, Gholamian, 4652, Gene Bank code 45994. This shrubby plant species is an annual that grows in desert and semi-desert areas of foothills, plains, slopes, and semi-elevation areas of southern and central provinces of Iran (Assadi, 2005; Rechinger & Schiman-Czeika, 1974). The chromosome number of this species, 2n=2x=12 (Fig.1G), is consistent with another report from Spain (Fernandez Casas and Garcia, 1979).

This species is distributed in West Asia, part of Europe, and Africa, and this is the first chromosome report of the species in Iran.

Primulaceae

Androsace maxima L.

Specimen examined: Iran, Chaharmahal and Bakhtiari Province, Lordegan, 1830, Gholamian, 107, GenBank code 47390. This species is an annual plant that has a wide distribution from Morocco in the West to Mongolia in the East (Weiss and Schneeweiss, 2001). For this species, x=10 chromosomes have been

reported in various studies, and on this basis, different ploidy levels from diploid to hexaploid have been described (Aryavand, 1980; Krasnikov, 1991). The chromosome number in the studied species was 2n=4x=40 (Fig. 1H), which is in agreement with previous reports.

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