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CHROMOSOME REPORT OF TWELVE SPECIES FOR THE FLORA OF IRAN

M. Sedaghati, F. Asadi-Corom, S.M. Ghaffari, A. Jalili & M. Amini Rad

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Original meiotic chromosome counts are presented for 12 species in seven families of Angiosperms from Iran, including *Allium lngisepalum* Bertol. (n=8), *Allium cristophii* Trautv. (n=8), *Allium scabriscapum* Boiss. & Kotschy (n=8), *Centaurea gaubae* (Bornm.) Wagenitz (n=14), *Leucanthemum vulgare*, (n=18), *Tragopogon vaginatum* (n=6), *Ferula persica* Willd. (n=11), *Zosima absinthifolia* (Vent.) Link. (n=5), *Lathyrus rotundifolius* Willd. (n=7), *Erodium oxyrrhychum* M. Bieb. subsp. *Oxyrrhychum* (n=20), *Agrimonia procera* (Rosaceae) (n=28), *Dendrostellera lessertii* Van Tiegh (n=9). Three counts are reported for the first time and eight meiotic studies are presented here for the first time.

Mansoureh Sedaghati (correspondence<sedaghati2012@gmail.com>) & Fereshteh Asadi-Corom, Department of Biotechnology, Research Institute of Forests and Rangelands, Agricultural Research, Education and Extension Organization (AREEO), Tehran, Iran.- Seyed Mahmood Ghaffari, Institute of Biochemistry and Biophysics, University of Tehran, Tehran, Iran.- Adel Jalili & Mohammad Amini Rad, Research Institute of Forests and Rangelands, Agricultural Research, Education and Extension Organization (AREEO), Tehran, Iran.

Keywords: Meiotic chromosome count; Angiosperm; Flora of Iran

گزارش کروموزومی ۱۲ گونه از فلور ایران

منصوره صداقتی: محقق بخش تحقیقات بیوتکنولوژی موسسه تحقیقات جنگلها و مراتع کشور، سازمان تحقیقات، آموزش و ترویج کشاورزی، تهران، ایران.

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سید محمود غفاری: استاد موسسه تحقیقات بیوشیمی و بیوفیزیک دانشگاه تهران، تهران، ایران

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

محمد امینی‌راد: دانشیار پژوهش، موسسه تحقیقات جنگلها و مراتع کشور، سازمان تحقیقات، آموزش و ترویج کشاورزی، تهران، ایران.

شمارش اولیه کروموزوم میوزی برای ۱۲ گونه در هفت خانواده از نهاندانگان از ایران ارائه شده است که عبارتند از: Allium longisepalum (n=۸)، Allium cristophii (n=۸)، Allium scabriscapum (n=۸)، Centaurea gaubae (n=۱۴)، Leucanthemum vulgare (n=۱۸)، Tragopogon vaginatum (n=۶)، Ferula persica (n=۱۱)، Zosima absinthifolia (n=۵)، Lathyrus rotundifolius (n=۷)، Erodium oxyrrhychum Subsp. Oxyrrhychum (n=۲۰)، Agrimonia procera (n=۲۸) و Dendrostellera lessertii (n=۹). سه شمارش برای اولین بار گزارش می‌شود و هشت مطالعه میوز نیز برای اولین بار ارائه می‌گردد.

INTRODUCTION

Six species from two very important and large genera of Angiosperms families including Amaryllidaceae and Asteraceae were selected and studied. Furthermore, six species were selected from the Apiaceae, Fabaceae, Rosaceae, Thymelaeaceae, and Geraniaceae families. The value of chromosomal information (number and behavior) to an improved taxonomic understanding of many groups of seed plants has been cited repeatedly (Stace 2000). Particularly in recent years, there have been numerous papers reporting chromosome counts for miscellaneous Angiosperms. In a project of a comprehensive study of chromosome counts and preparing a chromosome database for the species of the flora of Iran, the counting of mitotic or primary meiotic chromosomes for 12 angiosperm species was examined. Here we report the counts for these species.

MATERIALS AND METHODS

The data of the plant material studied here are shown in Table 1. For meiotic studies, floral buds of plants found in nature were collected and immediately fixed in Carnoyś fluid containing ethanol 96% and Glacial acetic acid, 3:1 (v/v) for 24 hours at room temperature. Anthers dissected out from the buds were squashed and stained with 2% acetocarmine. Chromosome counts were obtained from a minimum of 50 pollen mother cells within each collection.

RESULTS AND DISCUSSION

Amaryllidaceae

Allium longisepalum Bertol.

The major center of diversity of the genus *Allium* is in the Eastern Mediterranean, Southwestern, and Central Asia (Fritsch & Abbasi 2013). Floristic and taxonomic investigations detected 121 *Allium* species and subspecies occurring in Iran (Fritsch and Maroofi, 2010). Most Allium species are diploid. Polyploidy is less common but occurs among some cultivated forms, as well as in wild species (Havey 2002). The base number of chromosomes x= 8 dominates (Fritsch and Astanova 1998; Fritsch and Abbasi 2013), but other numbers (x= 7, 9, 10, 11) have also been reported (Fritsch and Astanova 1998; Fritsch and Abbasi 2013). *Allium longisepalum* was diploid with 2n=16 and showed (8-8) chromosome segregation at anaphase I (Fig. 1-A). According to our knowledge, this is the first chromosome number report for this species.

Allium cristophii Trautv.

Previous somatic chromosome numbers (2n=16) have been reported by Pederson and Wendelbo (1966) from Iran (Mazandaran, Haraz). Our sample was diploid and showed eight bivalents at metaphase I (Fig. 1-B). The gametic chromosome number (n=8) for this taxon is reported here for the first time.

Allium scabriscapum Boiss. & Kotschy

Allium scabriscapum is mainly distributed in montane and submontane areas of the Alborz, Zagros, and Koppet Dagh ranges and a few localities westward in E Anatolia, NE Iraq, and Transcaucasia. Meiosis in this taxon showed eight bivalents at diplotene (Fig. 1-C). The result agrees with the previous somatic chromosome number (2n=16) reports by Pogosian (1983) and Vakhtina (1985). The gametic chromosome number (n=8) for this taxon is reported here for the first time and the first report for the flora of Iran.

Asteraceae

Centaurea gaubae (Bornm.) Wagenitz

The genus *Centaurea* in Iran has about 109 species, 55% of which are endemic to Iran (Negaresh 2018). Meiosis in this species was regular and showed 14 bivalents at metaphase I (Fig. 1-D), which is in agreement with the previous report by Ghaffari and Shahraki (2001) from a different locality.

Leucanthemum vulgare Lam.

Leucanthemum vulgare Lam., is a perennial herb. This ornamental plant is indigenous to Europe but also distributed widely in North America, Africa, East Asia, and Australia (David and al. 2004). In Iran, the plant distribution is limited to northwest provinces i.e. Ardabil and East Azerbaijan (Mozaffarian 2008; Jacob 2008). According to the literature, *Leucanthemum vulgare* Lam. has three races of euploidy: 2x, 4x, and 6x, with 2n= 18, 36, 36 +0-3B, 54, and 54+0-4B chromosomes, respectively (Zelený , 1974; Goldblatt 1981-1988; Goldblatt and Johnson 1990-2003). However, our sample showed that *Leucanthemum vulgare* is a tetraploid species with gametic chromosome numbers of n=18 (Fig. 1-E). This is the first chromosome number report for the flora of Iran.

Tragopogon vaginatum Ownbey & Rech.f.

Previous somatic chromosome number (2n=12) has been reported by Moghimifam and al. (2009) from Iran (Ajabshir). Meiosis in our sample showed six bivalents at metaphase I (Fig. 1-F), which agrees with the previous reports. Gametic chromosome number is reported here for the first time.

Apiaceae

Ferula persica Willd.

All *Ferula* species are diploid with 2n=22 (Fedorov 1974; Goldblatt 1981-1988; Goldblatt & Johnson 1990-2003). Our sample showed n=11 in the meiosis division (Fig. 1-G), which agrees with the previous somatic chromosome number report by Mirzadeh Vaghefi & Jalili (2017).

Zosima absinthifolia (Vent.) Link.

There are two reports for *Zosima absinthifolia*: Vogt & Aparicio (1999) as diploid (2n=10), and Shner (2005) as tetraploid (2n=20).

Our sample was diploid with a gametic chromosome number of n=5 (Fig. 2-H).

Fabaceae

Lathyrus rotundifolius Willd.

The genus *Lathyrus* comprises nearly 187 species of annual and perennial plants that occur throughout the temperate regions of the northern hemisphere and South America. All *Lathyrus* species are diploid (2n=2x=14) with the basic number of x=7 (Battistin & Fernandez 1994). However, Khawaja and his colleagues (1995) reported an American and British form of *Lathyrus palustris* as a perennial plant and natural autohexaploid, having 2n=42 chromosomes. The induced tetraploids (2n=28) of *Lathyrus odoratus* L. and *L. pratensis* L. were also produced by Khawaja and his colleagues (2004). *Lathyrus rotundifolius* Willd. was diploid and showed seven bivalents at metaphase I, more of which were ring-shaped with two chiasmata (Fig. 2-I). Our count agrees with the previous reports on somatic chromosome number (2n=14) (Goldblatt & Johnson 1990-2003).

Geraniaceae

Erodium oxyrhinchum M. Bieb. **subsp. *oxyrhinchum***

Genus *Erodium* contains 74 annual and perennial species distributed on all continents except Antarctica. The Mediterranean basin region is a major center of diversity of the genus with 62 species, unlike other continents which have fewer native species**.** Flora of Iran comprises 15 species of *Erodium*, distributed in different parts of Iran (Schonbeck-Temesy 1970, Janighorban 2009). There are chromosomal data reported for 68 species, of which forty-six species are diploid; however, they reveal three different basic numbers: x=8 (2n=16), x=9 (2n=18), and x=10 (2n=20), (Fiz and al. 2006). Seven species are polyploid and reveal three different ploidy levels: tetraploid (2n=4x=36 and 40), hexaploid (2n=6x=60), and octoploid (2n=8x=80), (Carolin 1958; Guittonneau 1965a, 1966, 1967; Kentzinger 1974; Diaz & al., 1992; Fiz & al. 2006). Our sample was tetraploid and showed 20 bivalents at diakinesis (Fig. 2-J) which is in disagreement with the previous chromosome number reports (2n=18) by Badr & Hamoud (1985), (2n=20) by Keshavarzi & al., (2015) and Martin & al., (2020). Gametic chromosome numbers are reported here for the first time.

Table 1. The collection data of the material examined.

No.	Species	Location	Geographical Coordinates
1	*Allium longisepalum* Bertol	58 km from Tehran-Qom highway, 1084m, Ghaffari, Asadi-Corom, and Hasani Nejad.	E 51°03′10″ N 35°11′57″
2	*Allium cristophii* Trautv.	Cultivated in the National Botanical Garden of Iran, 1320m, Ghaffari, and Sedaghati.	E 51°17′40″ N 35°73′90″
3	*Allium scabriscapum* Boiss. & Kotschy	58 km from Tehran-Qom highway, 1084m, Ghaffari, Asadi-Corom, and Hasani Nejad.	E 51°03′10″ N 35°11′57″
4	*Centaurea gaubae* (Bornm.) Wagenitz	58 km from Tehran-Qom highway, 1084m, Asadi-Corom, and Hasani Nejad, Ghaffari.	E 51°03′10″ N 35°11′57″
5	*Leucanthemum vulgar* Lam.	Cultivated in the National Botanical Garden of Iran, 1320m, Ghaffari, and Sedaghati.	E 51°17′40″ N 35°73′90″
6	*Tragopogon vaginatum* Ownbey & Rech.f.	Cultivated in the National Botanical Garden of Iran, 1320m, Ghaffari, and Sedaghati.	E 51°17′40″ N 35°73′90″
7	*Ferula persica* Willd.	Northwest of Tehran- The end of Imamzadeh Dawood road in Kan sector, 2600m, Amini Rad, 106289.	E 51°33′78″ N 35°87′70″
8	*Zosima absinthifolia* (Vent.) Link.	58 km from Tehran-Qom highway, 1084m, Ghaffari, Asadi-Corom, and Hasani Nejad.	E 51°03′10″ N 35°11′57″
9	*Erodium oxyrhinchum* M. Bieb. subsp. *oxyrhinchum*	58 km from Tehran-Qom highway, 1084m, Ghaffari, Asadi-Corom, and Hasani Nejad.	E 51°03′10″ N 35°11′57″
10	*Agrimonia procera* Wallr.	Cultivated in the National Botanical Garden of Iran, 1320m, Ghaffari, and Sedaghati.	E 51°17′40″ N 35°73′90″
11	*Dendrostellera lessertii* (Wikstr.) Van Tiegh.	58 km from Tehran-Qom highway, 1084m, Ghaffari, Asadi-Corom, and Hasani Nejad.	E 51°03′10″ N 35°11′57″
12	*Lathyrus rotundifolius* Willd.	58 km from Tehran-Qom highway, 1084m, Ghaffari, Asadi-Corom, and Hasani Nejad.	E 51°03′10″ N 35°11′57″

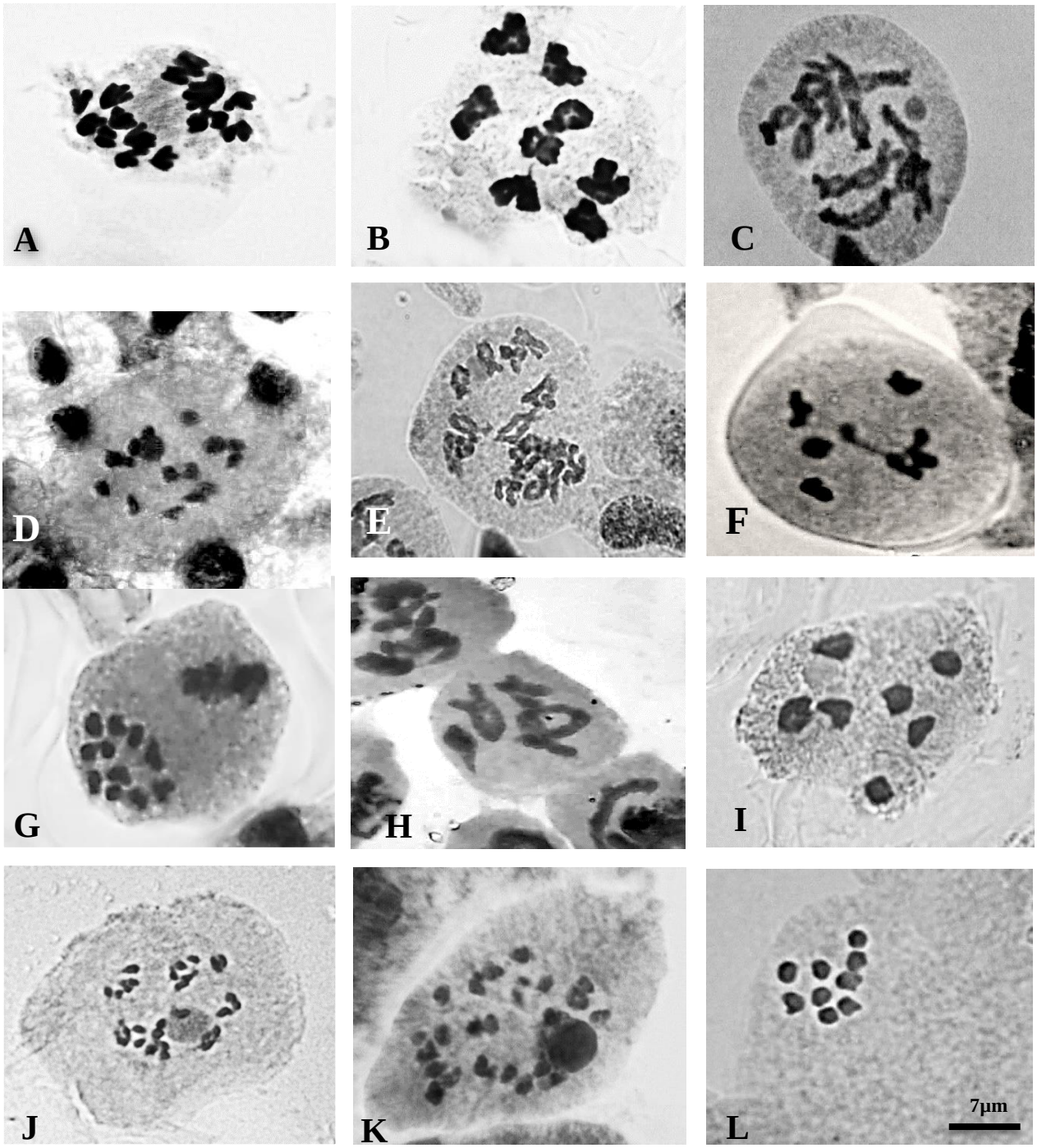

Fig. 1: A*: Allium longisepalum* (n=8); B: *Allium cristophii* (n=8); C: *Allium scabriscapum*) (n=8); D: *Centaurea gaubae* (n=14); E: *Leucanthemum vulgare* (n=18); F: *Tragopogon vaginatum* (n=6); G: *Ferula persica* (n=11), H: *Zosimia absinthifolia* (n=5), I*: Lathyrus rotundifolius* (n=7); J*: Erodium oxyrrhychum* Subsp. *Oxyrrhychum* (n=20);K: *Agrimonia procera* (n=28); L: *Dendrostellera lessertii* (n=9). Scale bars for all pictures=7µm.

Rosaceae

Agrimonia procera Wallr.

According to the literature, the genus *Agrimonia* has a basic chromosome number x=14, with three races of ploidy (diploid with 2n=28, triploid with 2n=42, and tetraploid with 2n=56). Our sample was tetraploid and showed 28 bivalents at metaphase I (Fig. 2-K), which is in agreement with previous reports (Goldblatt & Johnson 1990-2003). This is the first report on the flora of Iran.

Thymelaeaceae

Dendrostellera lessertii (Wikstr.) Van Tiegh**.**

This species was diploid and showed nine bivalents at metaphase I (Fig. 2-L) which is in agreement with a previous report by Ghaffari (1985), but from a different locality in Iran.

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