

CHROMOSOME NUMBERS OF FIFTEEN SPECIES OF PLANTAGO L. (PLANTAGINACEAE) FROM IRAN

S. Mohsenzadeh., V. Nazeri & S. M. Mirtadzadini

Received: 20.10.2007. Accepted for publication: 12.03.2008.

Mohsenzadeh, S., Nazeri, V. & Mirtadzadini, S. M.: 2008 06 30: Chromosome numbers of fifteen species of *Plantago* L. (*Plantaginaceae*) from Iran. –*Iran. J. Bot.* 14 (1): 47-53. Tehran.

Chromosome numbers of 15 species of *Plantago* L. of Iran were investigated. They include first counts for 2 taxa: *P. stocksii* Boiss. (2n=10) and *P. loeflingii* L. (2n=24), as well as 3 new chromosome numbers for 3 taxa: *P. albicans* Boiss. (2n=8 & 10), *P. coronopus* L. subsp. *commutata* Pilger. (2n=10) and *P. coronopus* subsp. *coronopus* Pilger (2n=20). Diploid chromosome numbers of the taxa investigated varied between 2n=8 and 2n=24. Our results are compared with previous records.

Saeed Mohsenzadeh (correspondence), Vahideh Nazeri & Seied Mansour Mirtadzadini, Department of Biology, Faculty of Science, Shahid Bahonar University, Kerman, Iran.

Key words. *Plantago*, chromosome number, Iran, mitosis.

اعداد کروموزومی پانزده گونه جنس *Plantago* L. (*Plantaginaceae*) از ایران

سعید محسن زاده،

وحیده ناظری،

سید منصور میرتاج الدینی،

اعداد کروموزومی برای ۱۵ گونه جنس *Plantago* از ایران بررسی شده است. اعداد کروموزومی برای سه گونه *P. loeflingii* (2n=24) و *P. stocksii* (2n=10) برای اولین بار و برای گونه *P. albicans* (2n=10, 8) و دو زیر گونه *P. coronopus* subsp. (*commutata* و *coronopus*) (2n=20) جدید می باشد. سطح دیپلوئیدی کروموزومی گونه های مطالعه شده از (2n=8) تا (2n=24) متغیر می باشد. نتایج بدست آمده با گزارشات قبلی مقایسه شده است.

Introduction

The genus *Plantago* L. comprises 483 species distributed throughout the world (Tutel et al. 2005). According to Pilger (1937) the genus is divided into two subgenera: *Euplantago* Harms. and *Psyllium* Harms. Rahn (1978) subdivided the genus into three subgenera including *Plantago*, *Coronopus* Rahn and *Psyllium* Rahn. Recently, Rahn (1996) proposed a new original taxonomic scheme of the genus according to which genus *Plantago* includes 6 subgenera: *Plantago*, *Coronopus* Rahn, *Albicans* Rahn, *Psyllium* Juss, *Littorella* Rahn and *Bougueria* Rahn. Previous cytological knowledge of *Plantago* L. has revealed that this genus has three different basic chromosome numbers of x=4, 5 and 6. The basic number of x= 6 is the original number from which x= 5 & x= 4 have been derived. This number is present in the majority of species, x=5 is found in several groups particularly of

sect. *Leucopsyllium* and sect. *Coronopus*, whereas x=4 has been reported in only two species. Badr (1999) suggests that evolution in *Plantago* has probably involved reduction in the nuclear DNA content with the decrease in the number of chromosomes from x= 6 to x=5 to x=4.

As cytological data are of great importance for the understanding of relationship and evolution in angiosperms, an attempt is made in this work to give a survey of chromosome numbers of some species of *Plantago* occurring in Iran.

Material and Method

The investigation was based on counting mitotic chromosomes obtained from root tips of seeds collected from different regions in Iran as shown in table 1.

Table 1. Chromosome numbers of 15 *Plantago* L. species from Iran.

Taxon	Pop. No	Locality	Present study 2n	Previous reports 2n
<i>P. major</i> L.	1	Fars: Nourabad, Mohsenzadeh 1223	12	12
<i>P. coronopus</i> L. subsp. <i>commutata</i> Pilger	2	Fars: Kazeroon, Mohsenzadeh 1228	10	20
<i>P. coronopus</i> L. subsp. <i>coronopus</i> Pilger.	3	Mashhad: Mohammad abad and Jangal, Joharchi 1231	20	10
<i>P. loeflingii</i> L.	4	Fars: Kazeroon, Mohsenzadeh 1237	24	-
<i>P. notata</i> Lagasca subsp. <i>haussknechtii</i> Rech. f.	5	Hormozgan: Mirtadzadini 1241	12	12
<i>P. gentianoides</i> Sibth. & Sm. subsp. <i>griffithii</i> Rech. f.	6	Kerman: Sirjan, Mirtadzadini 1242	12	12
<i>P. amplexicaulis</i> Cav. subsp. <i>bauphula</i> Rech. f.	7	Fars: Kazeroon, Mohsenzadeh 1249	10	10
<i>P. lanceolata</i> L.	8	Fars: Kazeroon Mohsenzadeh 1257	12	12
<i>P. lagopus</i> L.	9	Fars: Kazeroon, Mohsenzadeh 1261	12	12
<i>P. albicans</i> Boiss.	10	Hormozgan: Sarha, Mirtadzadini 1265	8 & 10	20
<i>P. ovata</i> Forssk.	11	Fars: Kazeroon, Mohsenzadeh 1272	8	8
<i>P. stocksii</i> Boiss.	12	Baluchistan: Rasak, Mirtadzadini 1286	10	-
<i>P. ciliata</i> Desf. subsp. <i>lanata</i> Rech. f.	13	Hormozgan: Hajiabad, Mirtadzadini 1290	10	10
<i>P. bellardi</i> All. subsp. <i>deflexa</i> Rech. f.	14	Fars: Kazeroon, Mohsenzadeh 1299	10	10
<i>P. indica</i> L.	15	Baluchistan: Hiran, Mirtadzadini 1301	12	12
<i>P. psyllium</i> L.	16	Fars: Kazeroon, Mohsenzadeh 1307	12	12

Voucher specimens of all investigated taxa are deposited at the Herbarium, the Department of Biology, Faculty of Science, Kerman University (KUH). Root tips were pretreated for 4-5 hours in 0.002 M 8 hydroxyquinoline at 4-5 °C, fixed in 3:1 absolute ethanol: acetic acid and stained in 1% aceto-orcein after 15-30 seconds of hydrolysis in 1N HCL at room temperature. The counts were obtained from preparations which were squashed in 45% acetic acid.

Results

The chromosome numbers from 16 populations of the 15 species examined are given in Table 1.

1. *P. major* L. (Fig. 1)

This species is widely distributed in hyrcanian and Irano-Turanian regions in Iran. Its general distribution is America, Europe, Turkey, Afghanistan, Pakistan and Palestine (Janighorban 1995). Our count of 2n=12 agrees with that given by McCullagh (1934), Bassett & Crompton (1967) and Fujiwara (1956a).

2. *P. coronopus* L. subsp. *commutata* Pilger (Fig. 2)

This subspecies is distributed in Europe, Iran, west Asia, Pakistan and Palestine

(Janighorban 1995). This is the first time that the chromosome number of $2n=10$ is reported for this species. Previously Moore (1967) was reported $2n=20$.

3. *P. coronopus* L. subsp. *coronopus* (Fig. 3)

This subspecies is widely distributed in North America, Europe, South and East Mediterranean regions, Turkey, Iran, Afghanistan, Pakistan and Iraq (Janighorban 1995). The chromosome number of $2n=20$ is presented here for the first time. McCullagh (1934) and Fujiwara (1956b) were reported $2n=10$.

4. *P. loeflingii* L. (Fig. 4)

Geographic distribution of the species is Europe, Turkey, Caucasus, Iran, Pakistan, Iraq and Syria (Janighorban 1995). Chromosome number of $2n = 24$ is the first report for this species.

5. *P. notata* Lagasca subsp. *haussknechtii* Rech. f. (Fig. 5)

This species is found only in Saharo-Sindian regions of the country. Geographic distribution of the species is Iran and Iraq (Janighorban 1995). The chromosome number $2n=12$ confirms the count reported by Badr and El-Kholy (1987).

6. *P. gentianoides* Sibth. & Sm. subsp. *griffithii* Rech. f. (Fig. 6)

This subspecies occurs in Iran, Afghanistan, Pakistan, mountains of western Himalayas and Tibet (Janighorban 1995). The chromosome number of $2n=12$ confirms the count reported by McCullagh (1934).

7. *P. amplexicaulis* Cav. subsp. *bauphula* Rech. f. (Fig. 7)

This subspecies has wide distribution in Europe, Iran, Pakistan, northern Africa and Saudi Arabia (Janighorban 1995). The diploid chromosome number of $2n=10$ is in accordance with the count reported by McCullagh (1934) and Badr (1999).

8. *P. lanceolata* L. (Fig. 8)

This species is widely distributed throughout the world (Janighorban 1995). Our count of $2n=12$ agrees with the results of previous authors (McCullagh 1934; Matsuo & Noguchi 1989; and Briggs 1937).

9. *P. lagopus* L. (Fig. 9)

This taxon has a relatively wide distribution in Europe, Mediterranean regions of Turkey, Iran, Caucasus, Siberia, Afghanistan, Pakistan, Palestine, Iraq, Syria

and northern Africa (Janighorban 1995). Our count of $2n=12$ agrees with the counts reported by McCullagh (1934) and Badr (1978).

10. *P. albicans* Boiss. (Figs. 10 & 11)

This species is distributed in Sahara-Sindian and Mediterranean area (Janighorban 1995). The chromosome numbers of $2n=8$ & 10 are reported for the first time. We found $2n=8$ & $2n=10$ in two root chromosome numbers.

11. *P. ovata* Forssk. (Fig. 12)

This species is widespread in Europe, Iran, Caucasus, Middle Asia, Afghanistan, Pakistan, Palestine, Iraq, Syria and northern Africa. Nowadays it is treated as a nearly cosmopolitan species (Rahn 1979). The diploid chromosome number of $2n=8$ confirms the count reported by McCullagh (1934). This is the only species with chromosome number of $2n=8$ in Iran.

12. *P. stocksii* Boiss. (Fig. 13)

P. stocksii so far known occurs only in Iran, Afghanistan and Pakistan (Janighorban 1995). The chromosome number of $2n=10$ is reported for the first time.

13. *P. ciliata* Desf. subsp. *lanata* Rech. f. (Fig. 14)

P. ciliata subsp. *lanata* is distributed only in Afghanistan, Iran and Pakistan (Janighorban 1995). Our count of $2n=10$ agrees with that reported by Zohary (1967).

14. *P. bellardi* All. subsp. *deflexa* Rech. f. (Fig. 15)

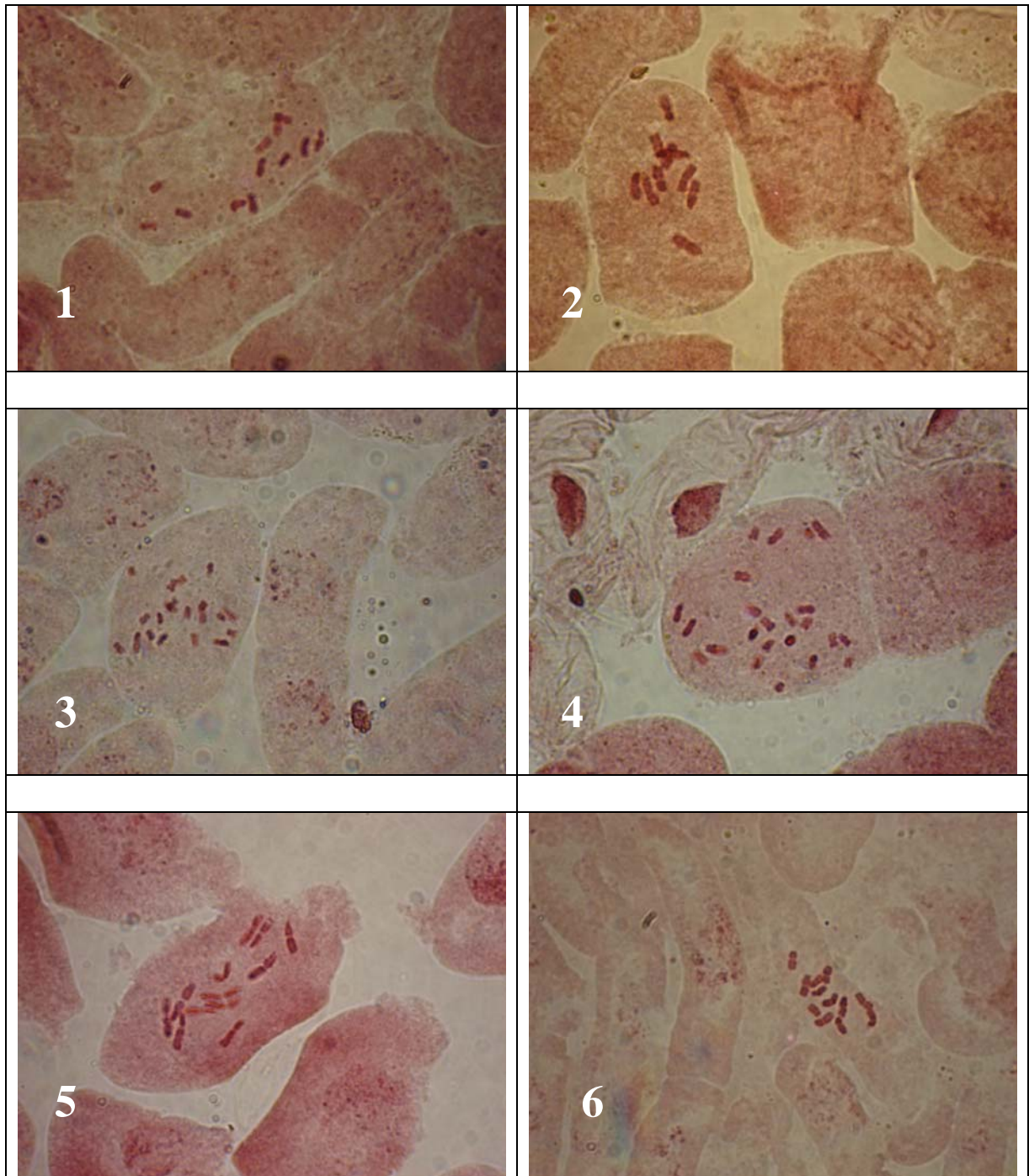
The geographic distribution of this subspecies is Iraq, Iran and Turkey (Janighorban 1995). The diploid chromosome number of $2n=10$ coincides with count reported by McCullagh (1934).

15. *P. indica* L. (Fig. 16)

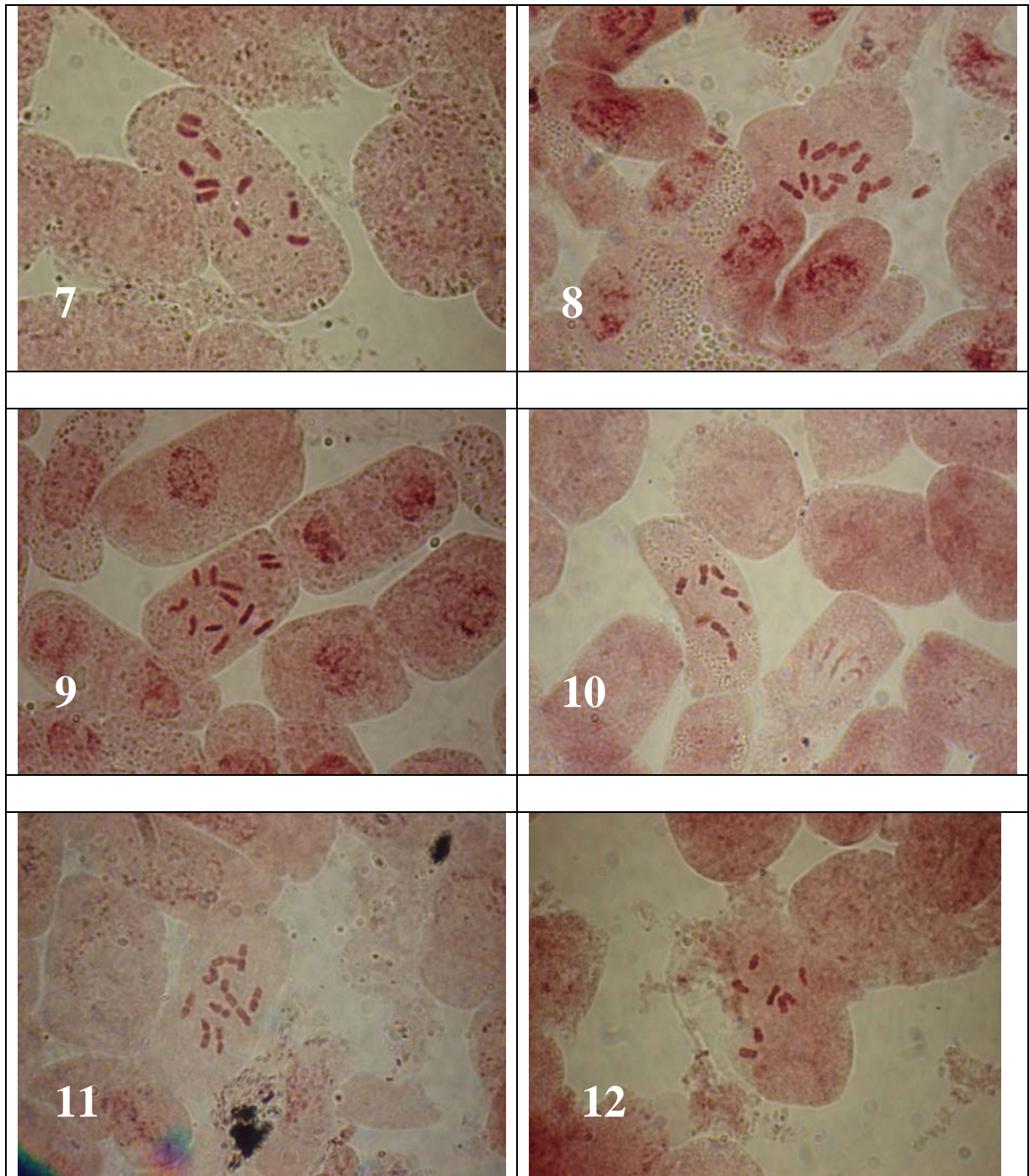
This species is widespread in Europe, Iran, Palestine and northern Africa (Janighorban 1995). Our count of $2n=12$ is in accordance with count reported by McCullagh (1934) and Fujiwara (1956b).

16. *P. psyllium* L. (Fig. 17)

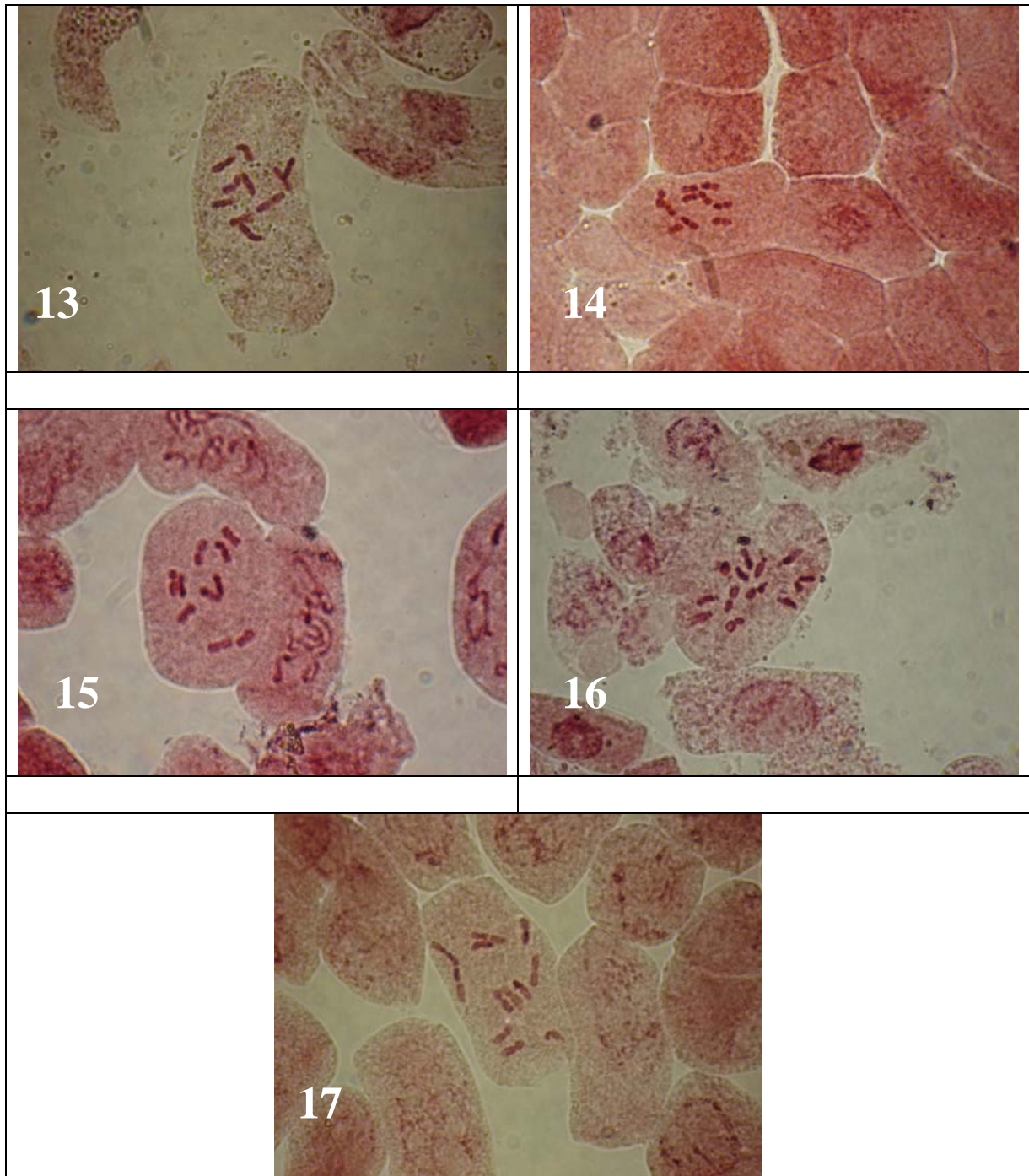
This species is widespread in Europe, Iran, Turkey, Middle Asia, Afghanistan, Pakistan, Palestine, Syria and northern Africa (Janighorban 1995). Our count of $2n=12$ agree with the report of McCullagh (1934) and Fujiwara (1956b).



Figs. 1-6: Somatic cells of *Plantago* species (X3000). 1. *P. major*; 2. *P. coronopus* subsp. *commutata*; 3. *P. coronopus* subsp. *coronopus*; 4. *P. loeflingii*; 5. *P. notata* subsp. *haussknechtii*; 6. *P. gentianoides* subsp. *griffithii*.



Figs. 7-12: Somatic cells of *Plantago* species (X3000). 7. *P. amplexicaulis* subsp. *bauphula*; 8. *P. lanceolata*; 9. *P. lagopus*; 10 & 11. *P. albicans*; 12. *P. ovata*.



Figs. 13-17: Somatic cells of *Plantago* species (X3000). 13. *P. stocksii*; 14. *P. ciliata* subsp. *lanata*; 15. *P. bellardi* subsp. *deflexa*; 16. *P. indica*; 17. *P. psyllium*.

Discussion

McCullagh (1934), Zohary (1972), Briggs (1937), Badr & El-Kholy (1978), Mastuo & Noguchi (1989), Badr (1999), Bassett & Crompton (1967) and Fujiwara (1956) gave the chromosome numbers of 13 *Plantago* species we studied as follows: *P. major* L. $2n=12$; *P. coronopus* L. subsp. *commutata* Pilger. $2n=20$; *P. coronopus* L. subsp. *coronopus* Pilger. $2n=10$; *P. notata* Lagasca. $2n=12$; *P. gentianoides* Sibth & Sm. $2n=12$; *P. amplexicaulis* Cav. subsp. *bauphula* Rech. f. $2n=10$; *P. lanceolata* L. $2n=12$; *P. lagopus* L. $2n=12$; *P. albicans* Boiss. $2n=20$; *P. ovata* Forssk. $2n=8$; *P. ciliata* Desf. subsp. *lanata*. Rech. f. $2n=10$; *P. bellardi* All. subsp. *deflexa* Rech. f. $2n=10$; *P. psyllium* L. $2n=12$; *P. indica* L. $2n=12$.

In volume 4 (Moore 1967) of Flora Europaea, the chromosome numbers of several *Plantago* species we studied were given as follows: *P. major* L. $2n=12$; *P. coronopus* L. subsp. *commutata* Pilger. $2n=20$; *P. coronopus* L. subsp. *coronopus* Pilger. $2n=10$; *P. gentianoides* Sibth & Sm. $2n=12$; *P. lanceolata* L. $2n=12$; *P. lagopus* L. $2n=12$; *P. albicans* Boiss. $2n=20$; *P. ovata* Forssk. $2n=8$; *P. bellardi* All. subsp. *deflexa* $2n=10$; *P. psyllium* L. $2n=12$.

A comparison between previous reports and our results revealed that the chromosome numbers for most taxa are similar. Our results for *P. albicans* Boiss. ($2n=8$ & 10), *P. coronopus* L. subsp. *commutata* Pilger. ($2n=10$) and *P. coronopus* L. subsp. *coronopus* Pilger. ($2n=20$), are different from previously published chromosome numbers.

References

- Badr, A. & El-Kholy, M. A. 1987: Chromosomal studies in the Egyptian Flora II. Karyotype studies in the genus *Plantago* L. -Cytologia 52: 725-731.
- Badr, S. F. 1999: Relationships of some *Plantago* species. -Taeckholmia 19 (1): 27-36.
- Bassett, I. J. & Crompton, C. W. 1967: Pollen morphology and chromosome numbers of the family Plantaginaceae in North America. -Cand. J. Bot. 46: 349-361.
- Briggs, B. D. 1973: Chromosomal studies on *Plantago* in Australia. -Contrib. New, Wales, Nation Herb 4: 399-405.
- Fujiwara, I. 1956a: Karyotype analysis in *Plantago* (I). -Lakromosome 27-28: 962-962.
- Fujiwara, I. 1956b: Karyotype analysis in *Plantago* (II). -Jap. Jour. Genet. 31: 184-191.
- Janighorban, M. 1995: *Plantago* in Assadi et al. Flora of Iran no.14: 1-53. -Research Institute of Forests and Rangelands.
- Matsuo, K. & Noguchi, J. 1989: Karyotype analysis of several *Plantago* species in Japan with special reference to taxonomic status of *Plantago japonica*. -J. Phytogeogr. and Taxon. 37 (1): 27-35.
- McCullagh, D. 1934: Chromosome and chromosome morphology in Plantaginaceae (1). -Gentica 16: 1-44.
- Moore, D. M. 1976: Plantaginaceae in Tutin et al. Flora Europaea 4: 38-44. -Cambridge Univ. Press, Cambridge.
- Pilger, R. 1937: Plantaginaceae in A. Engler Das Pflanzenreich 4, 269: 1-466. -Engelmann Verlag Berlin.
- Rahn, K. 1978: Nomenclatorial changes within the genus *Plantago* L., infraspecific taxa and subdivisions of the genus. -Bot. Tidsskrift 73: 106-111.
- Rahn, K. 1979: *Plantago* ser. *Ovatae*. A taxonomic revision. -Bot. Tidsskrift 74: 13-20.
- Rahn, K. 1996: A phylogenetic study of the Plantaginaceae. -Bot. J. Linn. Soc. 120:145-198.
- Tutel, B., Kandemir, I., Kus, S. & Kence, A. 2005: Classification of Turkish *Plantago* L. Species Using Numerical Taxonomy. -Turk. J. Bot. 29: 51-61.
- Zohary, M. 1972: Plantaginaceae in Flora Palaestina vol. 3: 220-232. -The Israel Academy of Sciences and Humanities.