

## Karyological Study on Turkish Endemic *Fritillaria baskilensis* Behçet. (*Liliaceae*)

\*Y. KIRAN, O. GEDİK

Fırat University, Faculty of Science and Arts, Department of Biology, Elazığ, Turkey  
\*ykiran@firat.edu.tr

(Received: 07.04.2014; Accepted: 10.07.2014)

### Abstract

Endemic *Fritillaria baskilensis* Behçet., which is found only in one locality of Elazığ-Baskil province (Selil mountain) in East Anatolia, was karyologically examined. Chromosome numbers of *Fritillaria baskilensis* were determined as  $2n=24$ . It was observed that chromosomes of the species examined had median region (m), submedian region (sm), subterminally (st), terminal region (t) and terminal point (T) centromeres. Haploid karyotype formula is  $2m + 2sm + 3st + 1t + 4T$ . Metaphase chromosome length ranged from 9.17 to 18.76  $\mu m$  and the total haploid chromosome length was 146.55  $\mu m$ . Karyotype analysis of *Fritillaria baskilensis* species has been conducted for the first time by us.

**Key words:** Chromosome number, *Fritillaria*, Karyotype, Liliaceae, Turkey

## Türkiye' ye Endemik *Fritillaria baskilensis* Behçet. (*Liliaceae*) Üzerine Karyolojik Çalışma

### Özet

Doğu Anadolu' da yer alan Elazığ' ın Baskil ilçesinde sadece bir lokalitede (Şelil dağı) bulunan endemik *Fritillaria baskilensis* Behçet., karyolojik olarak incelendi. Kromozom sayısı  $2n=24$  olarak belirlendi. İncelenen türün kromozomlarının median bölgesi (m), submedian bölgesi (sm), subterminal (st), terminal bölgesi (t) ve terminal noktalı (T) sentromerli olduğu görüldü. Haploid karyotip formülü  $2m + 2sm + 3st + 1t + 4T$  dir. Metafaz kromozomlarının boy uzunluğu 9.17  $\mu m$  ile 18.76  $\mu m$  arasında değişmekte ve toplam haploid kromozom boyu ise 146.55  $\mu m$  dir. *Fritillaria baskilensis* türünün karyotip analizleri ilk olarak tarafımızdan yapıldı.

**Anahtar kelimeler:** Kromozom sayısı, *Fritillaria*, Karyotip, Liliaceae, Türkiye

### 1.Introduction

Liliaceae family is represented worldwide by 250 genus and 3500 species. Turkey contains 35 genus and over 400 species. Liliaceae is a cosmopolitan family distributed in tropical and temperate regions. This family includes both medical and important ornamental plants [1]. The genus *Fritillaria* L. belongs to family Liliaceae, the species of the genus *Fritillaria* was first defined in 1753, as *F. pyrenaica* L., *F. imperialis* L., and *F. meleagris* L., *F. persica* L. [2,3]. *Fritillaria* is represented worldwide by 7 subgenera, 2 sections, and 165 taxa [4]. The *Flora of Turkey*, Volume 8 and Volume 11, recognised 41 taxa within Turkey, 19 of which were considered endemic. 18 species and 4 subspecies are distributed in the Mediterranean region, twelve of which are endemic [5]. The

genus *Fritillaria* is represented by 34 species and 7 subspecies in the *Flora of Turkey*. According to Tekşen and Aytaç (2011) the number of taxa was determined as 35 species and 6 subspecies, 21 of which are endemic [5]. The species of the *Fritillaria* genus are distributed particularly in the Mediterranean regions, eastern parts of Anatolia and Thrace, the Black Sea and Central Anatolia in Turkey, and in Iraq, Iran, Afghanistan, Russia, Syria, Palaestina, Lebanon, Jordan, China, Pakistan, Japan, Greece, Spain, Portugal, Bulgaria, North Africa, Italy and California and Oregon in the USA [6-19]. *F. baskilensis* was described as a species nova in 1998 and has very limited distribution at Baskil-Elazığ in Eastern Anatolia of Turkey [20, 21]. There are studies of the anatomical, morphological and palynological characteristics of species *F. baskilensis* [21]. However, there

has been no karyological investigation of species *F. baskilensis* so far. The purpose of this study is to determine the mitotic chromosome numbers, morphometric parameters, and karyotypes of *F. baskilensis* in order to clarify its taxonomy and make contributions to other multidisciplinary studies on the genus.

## 2. Materials and methods

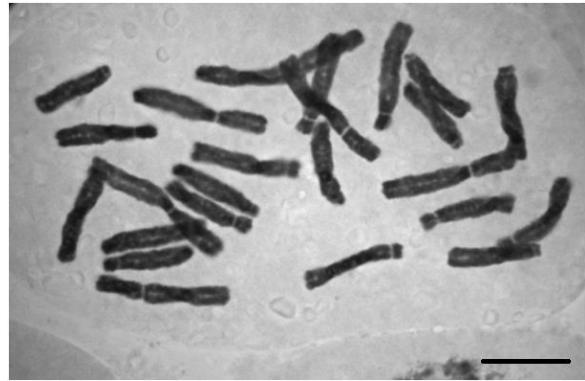
Plant materials were collected from natural habitats during fruiting season in 2014 in Turkey. The voucher specimens were deposited at the Firat University Herbarium (FUH). The karyological studies are conducted on the root tips of meristematic cells. The bulbs were germinated on moist filter paper in Petri dishes at 25 °C. The actively growing root tips were pretreated with aqueous colchicine (0.05%) for 6 h at room temperature. Afterwards the root tips were fixed with Farmer (1 : 3 glacial acetic acid–absolute ethanol) for at least 48 h at 4 °C, hydrolysed in 1 N HCl at 60 °C for 8 min, then rinsed in tap water for 3-5 min. Finally they were stained in Feulgen for 1 h and mounted in 45% acetic acid [22]. Digital microphotographs from at least 3 well-spread metaphase plates were taken using an Olympus BX51 microscope, and were recorded with an Olympus Camedia C-4000 digital camera. The short arm (s), long arm (l) and total lengths (tl) of each chromosome were measured with calipers whereas the relative lengths, arm ratios, and centromeric indices were determined from images of selected cells. Chromosomes were classified according to the nomenclature of Levan et al., [23]. The intrachromosomal asymmetry index (A1) and the interchromosomal asymmetry index (A2) are followed by Romero Zarco [24].

## 3. Results and discussion

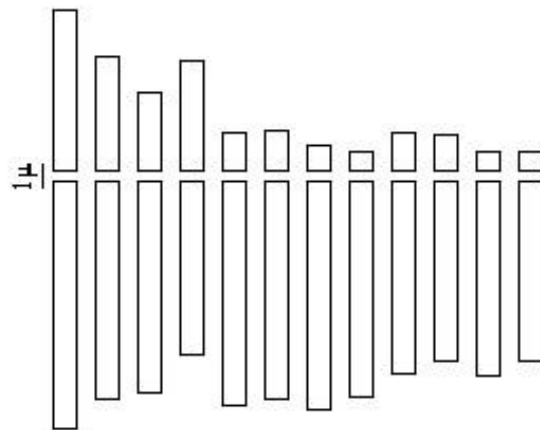
### *Fritillaria baskilensis* Behçet.

An endemic species of Elazığ which is grown in Elazığ-Baskil province (Selil mountain) in East Anatolia is known only from one locality [21]. B7 Elazığ, upper southeast of Kulusağı, is found in the lower slopes of the Selil mountain, 1400m, *Kiran 1023*, 04.04.2014. No data has been found regarding the chromosome number of the species *F. baskilensis*. As a result

of this study, diploid chromosome number was found as  $2n=24$ . Lengths of the chromosomes ranged from 9.17 to 18.76  $\mu\text{m}$  and the ratio of the longest to shortest chromosome is 2.0:1, haploid chromosome length is 146.55  $\mu\text{m}$ .



**Figure 1.** Somatic metaphases of *F. baskilensis* Scale bar 10  $\mu\text{m}$ .



**Figure 2.** Haploid idiogram of *F. baskilensis*

Chromosome arm ratios are measured as 1.52-10.33  $\mu\text{m}$ . Centromeric index varies between 8.81  $\mu\text{m}$  and 39.67  $\mu\text{m}$  and relative lengths vary from 6.26  $\mu\text{m}$  to 12.80  $\mu\text{m}$ . Chromosomes were 2 median region (m), 2 submedian region (sm), 3 subterminally (st), 1 terminal region (t) and 4 terminal point (T) centromeres (Table 1 and 2; Figures 1 and 2). Chromosome number and morphology of *F. baskilensis* have been determined for the first time by us. The chromosome number of *Fritillaria* is usually  $2n=24$ . Only two taxa of subgenus *Fritillaria*, i.e. *F. montana* and *F. ruthenica* Wikström, have  $2n=18$  chromosomes [25]. This chromosomal reduction is probably the result of successive chromosomal reconstructions and fusion of acrocentric

chromosomes into metacentric chromosomes [26-31]. Exceptionally, triploid karyotypes with  $2n = 3x = 36$  [25,28] or with  $2n = 3x = 27$  [28-

30] chromosomes are found [31]. The karyotype of *F. baskilensis* presented here, is different from *F. mughlae* and *F. forbesii*.

**Table 1.** Somatic chromosome number (2n), ploidy level, karyotype formula, ranges of chromosome length, total karyotype length (TKL), and asymmetry indexes (A<sub>1</sub>, A<sub>2</sub>) of Romero Zarco (1986) for the studied *F. baskilensis*

| Taxa                  | 2n | Ploidy level | Karyotype formula | Chromosome length range (µm) | TKL (µm) | A <sub>1</sub> | A <sub>2</sub> |
|-----------------------|----|--------------|-------------------|------------------------------|----------|----------------|----------------|
| <i>F. baskilensis</i> | 24 | 2x           | 2m+2sm+3st+1t+4T  | 9.17-18.76                   | 146.55   | 0.71           | 0.22           |

**Table 2.** Karyomorphological parameters of *F. baskilensis*

| Chromosome pair no | Total length | Long arm | Short arm | Arm ratio | Centromeric index | Relative length | Chromosome type |
|--------------------|--------------|----------|-----------|-----------|-------------------|-----------------|-----------------|
| 1                  | 18.76        | 11.32    | 7.44      | 1.52      | 39.67             | 12.80           | m               |
| 2                  | 15.28        | 9.98     | 5.30      | 1.88      | 34.67             | 10.43           | sm              |
| 3                  | 13.37        | 9.73     | 3.64      | 2.67      | 27.23             | 9.12            | sm              |
| 4                  | 13.01        | 7.96     | 5.05      | 1.57      | 38.83             | 8.88            | m               |
| 5                  | 12.08        | 10.30    | 1.78      | 5.78      | 14.74             | 8.24            | t               |
| 6                  | 11.91        | 9.98     | 1.93      | 5.17      | 16.20             | 8.13            | st              |
| 7                  | 11.70        | 10.46    | 1.24      | 8.43      | 10.60             | 7.98            | T               |
| 8                  | 10.90        | 9.94     | 0.96      | 10.33     | 8.81              | 7.44            | T               |
| 9                  | 10.61        | 8.80     | 1.80      | 4.86      | 17.03             | 7.24            | st              |
| 10                 | 9.90         | 8.23     | 1.67      | 4.92      | 16.88             | 6.76            | st              |
| 11                 | 9.78         | 8.88     | 0.89      | 9.87      | 9.19              | 6.67            | T               |
| 12                 | 9.17         | 8.26     | 0.90      | 9.08      | 9.91              | 6.26            | T               |

Karyotype formula of *F. baskilensis* 2m+2sm+3st+1t+4T and total length of the haploid complement is 146.55 µm. Karyotype formula of *F. mughlae* 1m+1sm+6st+4t and total length of the haploid complement is 165.56 µm, *F. forbesii* 1sm+3st+7t and total length of the haploid complement is 189.69 µm [19]. Examining the studies conducted on *Fritillaria*; it is specified that haploid chromosome number is determined as n=9 in *F. tenella* M. Bieb., n=12 in *F. acmopetala* Boiss., n=13 in *F. glauca* Greene., [28] and diploid chromosome number is determined as 2n=24 in *F. mughlae* Tekşen and Aytaç., and *F. forbesii* Baker., [19], 2n= 24, 25 in *F. anhuiensis* S.C. Chen and S.F. Yin., [32], 2n=36 in *F. camschatcensis* (L.) Ker Gawl., [33], 2n=18+6B in *F. tenella* M. Bieb., [34], 2n=24+1B in *F. mellea* S.Y. Tang and S.C. Yueh., [35], 2n=24+3B in *F. monantha* Migo., [32], 2n=24+4B in *F. qimenensis* D.C. Zhang and J.Z. Shao., [36]. In this study; chromosome number of the species of the *F. baskilensis* in

Elazığ was determined as 2n=24. Chromosome arm ratios are measured as 1.52-10.33 µm. Centromeric index varies between 8.81 µm and 39.67 µm, and relative lengths vary from 6.26 µm to 12.80 µm. Tables 1 and 2, Figures 1 and 2 illustrate karyotype analyses of the species examined. The chromosomes are generally terminal point (T) and subterminally (st). While intrachromosomal asymmetry index (A<sub>1</sub>) 0.71, interchromosomal asymmetry index (A<sub>2</sub>) 0.22 (Table 1). Chromosome number of the species *F. baskilensis* has been found for the first time by us and its karyotype analysis was performed as such.

#### 4. References

- Seçmen, Ö., Gemici, Y., Görk, G., Bekat, L. and Leblebici, E. (1998). Tohumlu Bitkiler Sistematigi. Ege Üniv. Fen Fak. Kitaplar Serisi, No: 110, İzmir.
- Linnaeus, C. (1753). Species Plantarum, pp. 303-304.

3. Linnaeus, C. (1754). *Genera Plantarum*, pp. 144.
4. Rix, E.M. (2001). *Fritillaria*: A Revised Classification. Edinburgh: The *Fritillaria* Group of the Alpine Garden Society, United Kingdom.
5. Tekşen, M. and Aytac, Z. (2011). The revision of the genus *Fritillaria* L. (Liliaceae) in the Mediterranean region (Turkey), *Turk J Bot.*, 35, 447-478.
6. Jordanov, D. (1964). *Flora Reipublicae Popularis Bulgaricae*, 2, 254-265.
7. Heywood, V.H. (1978). *Flowering Plants of the World*, pp. 309-314. London: Oxford University Press.
8. Lozina-Lozinskaya, A. (1968). *Fritillaria* L. In: Komarov VL (ed.), *Flora of the USSR*, Vol. 4, pp. 232-246. Israel: Israel Program for Scientific Translations.
9. Tutin, T.G. (1980). *Fritillaria* L. In: Tutin TG, Heywood VH & Burges NA (eds.), *Flora Europaeae*, Vol. 5, pp. 14-74. Cambridge: Cambridge University Press.
10. Pignatti, S. (1982). *Flora d'Italia*, Vol. 3, pp. 360-361. Bologna: Edagricole.
11. Rix, E.M. (1984). *Fritillaria* L. In: Davis PH (ed.) *Flora of Turkey and the East Aegean Islands*, Vol. 8, pp. 284-302. Edinburgh: Edinburgh University Press.
12. Feinbrun-Dothan, N. (1986). *Flora Palaestina*, Vol. 4, pp. 43-44. Jerusalem: Israel Academy of Sciences and Humanities.
13. Townsend, C.C. (1985). *Fritillaria* L. In: Townsend CC & Guest E (eds). *Flora of Iraq*. Vol. 8, pp. 42-185. Baghdad: The Whitefriars Press.
14. Meikle, R.D. (1985). *Verbascum* L In: Meikle RD (ed.), *Flora of Cyprus*. Vol. 2, pp. 1599-1600, Kew: Royal Botanic Gardens.
15. Rechinger, K.H. (1990). *Fritillaria* L. In: Rechinger, KH (ed.), *Flora Iranica*. Vol. 165, pp. 61-76. Graz, Austria: Akademische Druckund Verlagsanstalt.
16. Özhatay, N. (2000). *Fritillaria* L. In: Güner A, Özhatay N, Ekim T & Başer KHC (eds.). *Flora of Turkey and the East Aegean Islands* (suppl. 2). Vol. 11, pp. 243-246, Edinburgh: Edinburgh University Press.
17. Özhatay, N. and Kültür, Ş. (2006). Check-list of additional taxa to the supplement Flora of Turkey III. *Turk J Bot.*, 30: 281-316.
18. Tekşen, M. and Aytac, Z. (2004). New *Fritillaria* L. taxa from Turkey, *Israel J Plant Sci.*, 52: 357-365.
19. Tekşen, M. and Aytac, Z. (2008). *Fritillaria mughlae* (Liliaceae), a new species from Turkey, *Ann Bot Fenn*, 45: 141-147.
20. Behçet, L. (1998). A new species of *Fritillaria* L. (Liliaceae) from east anatolia Turkey. *Bull. Pure Appl. Sci.*, 17B (1-2), 35-38.
21. Pinar, S. M. and Behçet, L. (2012). Anatomical, morphological and palynological study on Turkish endemic *Fritillaria baskilensis* (Liliaceae). *Boccone*, 24, 305-310.
22. Kıran, Y., Turkoglu, I., Kırılmaz, F., Arabacı, T., Sahin, A. and Bağcı, E. (2012). Karyological investigation of six *Achillea* L. (Asteraceae) species growing in Turkey. *Caryologia*, 65, 101-105.
23. Levan, A., Fredga, K. and Sanberg, A.A. (1964). Nomenclature for centromeric position on chromosomes. *Hereditas*, 52, 201-220.
24. Romero, Z.C. (1986). A new method for estimating karyotype asymmetry. *Taxon*, 35, 526-530.
25. Fedorov, A. (ed.) (1969). *Hromosomnye ciska cvetkovykh rastenij* [Chromosome numbers of flowering plants]. Leningrad.
26. Darlington, C. D. (1930). Chromosome studies in *Fritillaria*. III. Chiasma formation and chromosome pairing in *F. imperialis*. *Cytologia*, 2, 37-59.
27. Darlington, C. D. (1936). The external mechanics of the chromosomes. *Proc. Roy. Soc. London, Biol. Sci.*, 121, 264-319.
28. La Cour, L. F. (1978a). The constitutive heterochromatin in the chromosomes of *Fritillaria* sp., as revealed by Giemsa banding. *Phil. Trans. Roy. Soc. London, Biol. Sci.*, 285(1004), 61-71.
29. La Cour, L. F. (1978b). Differential Giemsa staining of B-chromosomes of *Fritillaria tenella*. *Heredity*, 41, 101-103.
30. Kamari, G. (1991). The genus *Fritillaria* L. in Greece: taxonomy and karyology. *Bot. Chron.*, 10, 253-270.
31. Kamari, G. and Phitos, D. (2006). Karyosystematic study of *Fritillaria messanensis* s.l. (Liliaceae). *Willdenowia*, 36, 217-233.
32. Wang, Y. (2006). A karyotypical study on *Fritillaria* L. from Anhui Province. *J. Wuhan Bot. Res.*, 24(4), 303-309.
33. Nishikawa, T. (1986). Chromosome counts of flowering plants of Hokkaido. *J. Hokkaido Univ. Educ., Sect., 2B*, 37, 5-17.
34. Lovka, M. (1995). IOPB chromosome data 9. *Int. Organ. Pl. Biosyst. Newslett.* (Zurich) 24, 21-23.
35. Li, C.X., Wang, S. F. and Lei, H.L. (1996). Report on the karyotypes of 4 species in *Fritillaria*. *J. Agric. Univ. Hebei*, 19(2), 53-57.
36. Zhang, D.C., Shao, J.Z. and Wang, X.Q. (1992). Karyotypes of the genus *Fritillaria* from south Anhui. *Acta Phytotax. Sin.*, 30(1), 62-69.