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Karyology of the *Scorzonera* L. (Asteraceae) taxa from Turkey

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Abstract: In this study, the karyotypes of 13 taxa of the tribe Lactuceae growing naturally in Turkey were examined. Of the species of the genus *Scorzonera* L. (Asteraceae), *S. laciniata* L. subsp. *laciniata*, *S. cana* (C.A.Mey.) Hoffm. var. *jacquiniana* (W.Koch) Chamb., *S. suberosa* C.Koch subsp. *suberosa*, *S. mollis* M.Bieb. subsp. *mollis*, *S. papposa* DC., *S. lacera* Boiss. & Bal., *S. elata* Boiss., and *S. parviflora* Jacq. have a diploid chromosome number of 2n = 14. For *S. phaeopappa* (Boiss.) Boiss., this number is 2n = 28, and for *S. eriophora* DC., *S. pseudolanata* Grossh., *S. tomentosa* L., and *S. kotschyi* Boiss., it is 2n = 12. The average chromosome length of the taxa examined was between 1.20 and 7.63 µm. All of the taxa have median and submedian chromosome pairs in their chromosome morphologies. With the exception of *S. parviflora*, the chromosome morphologies of the taxa examined are presented here for the first time.

Key words: *Scorzonera*, Compositae, karyotype, Turkey

Türkiye'den *Scorzonera* L. (Asteraceae) taksonlarının karyolojisi

Özet: Bu araştırmada Türkiye'de doğal olarak yetişen *Lactuceae* tribusunda yer alan 13 taksonun karyotipleri incelendi. *Scorzonera* L. (Asteraceae) cinsine ait *Scorzonera laciniata* L. subsp. *laciniata*, *S. cana* (C.A.Mey.) Hoffm. var. *jacquiniana* (W.Koch) Chamb., *S. suberosa* C.Koch subsp. *suberosa*, *S. mollis* M.Bieb. subsp. *mollis*, *S. papposa* DC., *S. lacera* Boiss. & Bal., *S. elata* Boiss. ve *S. parviflora* Jacq. 2n = 14; *S. phaeopappa* (Boiss.) Boiss. 2n = 28; *S. eriophora* DC., *S. pseudolanata* Grossh., *S. tomentosa* L. ve *S. kotschyi* Boiss. ise 2n = 12 kromozoma sahip türlerdir. İncelenen taksonların ortalama kromozom uzunlukları 1,20-7,63 µm'dir. Bütün taksonların kromozom morfolojileri median ve submedian kromozom çiftlerini içermektedir. *S. parviflora* hariç taksonların kromozom morfolojileri ilk defa sunuldu.

Anahtar sözcükler: *Scorzonera*, Compositae, karyotip, Türkiye

Introduction

Asteraceae is the largest family of flowering plants, with approximately 1620 genera and more than 23,600 species (1). Asteraceae is widely distributed within diverse regions ranging from the southwestern United States, Mexico, and southern Brazil to South Africa, middle and southwestern Asia, and Australia. South America is acknowledged as the geographic origin of the family phylogenetically (2).

Asteraceae represents the largest number of species in the flora of Turkey and the East Aegean Islands, with the total number of recorded species at

1209. Of these, 447 species are endemic, making the endemism rate 37%. This family is the second largest family of the Turkish flora, with a total of 134 genera (3,4).

The subtribe Scorzonerinae includes the genera *Epilasia* (Bunge) Benth., *Geropogon* L., *Koelpinia* Pall., *Pterachaenia* (Benth.) Lipsch., *Scorzonera* L., *Tourneuxia* Coss., and *Tragopogon* L. and contains about 300 species (5).

The genus *Scorzonera*, which is of ancient Mediterranean origin, includes approximately 180 species and is widely spread among the arid regions of Eurasia and northern Africa (6,7). The first thorough analysis of the genus *Scorzonera* was provided by de Candolle (8). According to his system, the genus *Scorzonera* combines perennial herbs and shrubs with simple, entire, rarely pinnatifid leaves, phyllaries always deprived of horns, and seeds mainly with or without hollow pedicels. Considerable changes in the treatment of the genus *Scorzonera* were introduced by Boissier (1875), who included *Podospermum* DC. and *Epilasia* (Bunge) Benth. as sections within the genus *Scorzonera* (9). The most complete and different system was given by Lipschitz in 2 parts of his classical *Fragmente monographiae Scorzonera* (10,11). The concept of the genus introduced by Lipschitz has been accepted for many regional floras (12-14).

The genus *Scorzonera* is represented by 39 species and 4 subspecies and varieties in *Flora of Turkey and the East Aegean Islands* (12). After the publication of that work, 3 new taxa were added to the supplementary work (15). Recently, *Scorzonera ekimii* A.Duran, *S. adilii* A. Duran, *S. ulrichii* Parolly & N.Kilian (= syn: *S. gokcheoglui* O.Ünal & R.S.Göktürk), *S. karabelensis* Parolly & N.Kilian, *S. yildirimlii* A.Duran & Hamzaoğlu, *S. aytatchii* A.Duran & Sağıroğlu (*S. rigida* Aucher = syn: *S. aytatchii* A.Duran & Sağıroğlu), and *S. ketzkhovelii* Grossh. have been described. Currently, the genus *Scorzonera* is represented in Turkey by 48 species, 4 subspecies, and 4 varieties, of which 28 taxa are endemic to the country (7,16-23).

Mechanisms such as chromosomal rearrangements or changes in the basic chromosome number or in ploidy level are usually accompanied by plant speciation and diversification (24,25). In this sense, any additional data completing or verifying the karyological knowledge are relevant. Apart from other karyological and cytogenetic investigations, the determination of chromosome numbers in many populations throughout the distribution range of a given species represents a primary and essential step through which such events as dysploidy, aneuploidy, or polypoloidy can be revealed (25).

Somatic chromosome numbers of the genus *Scorzonera* have been reported in previous studies (26-43). Although chromosome counts have been reported for many species in *Scorzonera*, few researchers have described the karyotypes of its species. The lack of karyological studies in *Scorzonera* is probably a result of the difficulties faced in attempting to germinate the seeds properly.

Therefore, the aim of this study was to verify or establish the karyotypes of the taxa mentioned above from Turkey. This study could play an important role in clarifying this taxonomically complex genus with morphologically unsolved problems.

Materials and methods

Karyotype analyses were done on mitotic metaphase chromosomes prepared using the squash technique. Voucher specimens were deposited in the herbarium of Selçuk University. The root tips were pretreated with α-monobromonaphthalene solution (0.8%) at 4 °C for 16 h. After washing with distilled water, the material was fixed in fresh Carnoy's solution (3:1 ethanol and glacial acetic acid) overnight at 4 °C and stored in 70% ethanol at 4 °C. This material was hydrolyzed with 1 N HCl for 10 min at room temperature, washed with distilled water, stained with 2% acetic orcein, and squashed in 45% acetic acid. Preparations were made permanent by using the standard liquid nitrogen method and mounted in Depex. At least 5 metaphase plates were measured for each taxon. Chromosomes were classified using the nomenclature established in a previous study (44). The chromosome measurements were calculated with the Bs200Pro Image Analysis System (45).

Results and discussion

The specimens of the genus *Scorzonera* were collected from different districts in Turkey (Table). Karyotype

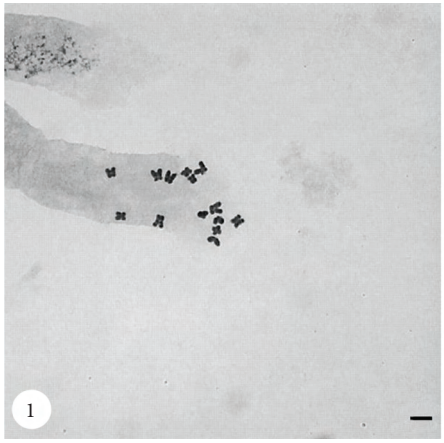
analyses of the 13 species from different localities were carried out. The mitotic cells of the taxa examined have diploid chromosome numbers of 2n = 12, 14, and 28. The somatic chromosome number of *Scorzonera laciniata* subsp. *laciniata*, *S. cana* var. *jacquiniana*, *S. suberosa* subsp. *suberosa*, *S. mollis* subsp. *mollis*, *S. papposa*, *S. lacera*, *S. elata*, and *S. parviflora* was determined to be 2n = 14; for *S. phaeopappa*, 2n = 28; and for *S. eriophora*, *S. pseudolanata*, *S. tomentosa*, and *S. kotschyi*, 2n = 12. Overall, it can be seen that most of the investigated taxa exhibited very similar chromosome morphologies.

Scorzonera laciniata subsp. ***laciniata***

Karyotype analysis determined that this taxon has a chromosome number of 2n = 14 (Figure 1). The shortest chromosome length is 1.20 µm, the longest is 2.12 µm, and the haploid chromosome length is 11.44 µm. Of the metaphase chromosomes, 3 pairs are of the median type and 4 pairs are submedian. Chromosome arm ratios were measured at 1.17-2.73. The centromeric index values varied between 3.89 and 7.15, and the relative lengths varied from 10.45 to 18.48. An ideogram of the taxon was drawn using the Image Analysis System (Figure 2).

Table. Localities and collectors of the taxa studied.

Taxa	Localities	Collectors and No.
S. laciniata subsp. *laciniata*	Erzurum	Makbul 84
S. cana var. *jacquiniana*	Konya	A.Duran 8032 & M.Öztürk
S. suberosa subsp. *suberosa*	Sivas	A.Duran 6986
S. mollis subsp. *mollis*	Giresun	Makbul 080
S. papposa	Mardin	A.Duran 7821
S. lacera	Konya	A.Duran 8041 & M.Öztürk
S. elata	Burdur	A.Duran 7337
S. parviflora	Sivas	Makbul 88
S. phaeopappa	Osmaniye	A.Duran 6914
S. eriophora	Konya	A.Duran 8039 & M.Öztürk
S. pseudolanata	Sivas	A.Duran 6985
S. tomentosa	Erzurum	A.Duran 7564 & B.Doğan
S. kotschyi	Kahramanmaraş	A.Duran 7484, B.Doğan & M.Öztürk



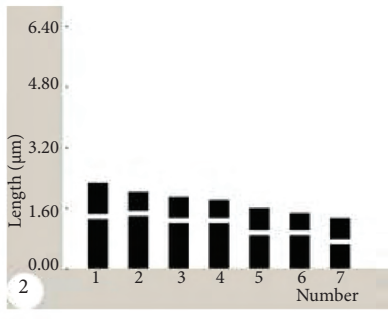


Figure 1. Somatic metaphase in *Scorzonera laciniata* subsp. *laciniata* (2n = 14).
Figure 2. Ideogram for *S. laciniata* subsp. *laciniata*, scale bars: 5 µm.

Scorzonera cana var. ***jacquiniana***

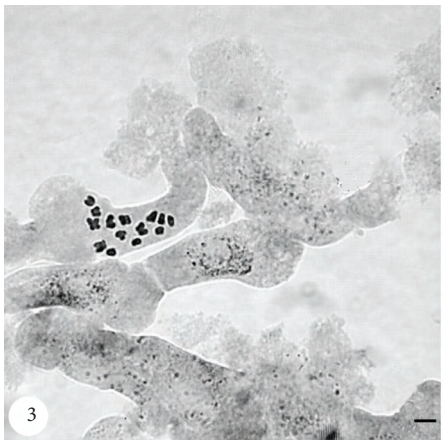
It was determined by karyotype analysis that this taxon has a chromosome number of 2n = 14 (Figure 3). The shortest chromosome length is 2.21 µm, the longest is 3.87 µm, and the haploid chromosome length is 20.15 µm. Of the metaphase chromosomes, 4 pairs are of the median type and 3 pairs are submedian. Chromosome arm ratios were measured at 1.23-2.22. The centromeric index values varied between 4.27 and 6.35, and relative lengths were found to vary from 10.94 to 19.18. An ideogram of the taxon was drawn using the Image Analysis System (Figure 4).

Scorzonera suberosa subsp. ***suberosa***

Karyotype analysis of this taxon revealed that it has a chromosome number of 2n = 14 (Figure 5). The shortest chromosome length is 1.92 µm while the longest is 3.16 µm, and the haploid chromosome length is 17.39 µm. Of the metaphase chromosomes, 5 pairs are of the median type and 2 pairs are submedian. Chromosome arm ratios were measured at 1.19-1.83. Centromeric index values varied between 3.94 and 8.30, and relative lengths ranged from 11.04 to 18.16. An ideogram of the taxon was drawn using the Image Analysis System (Figure 6).

Scorzonera mollis subsp. ***mollis***

Using karyotype analysis, it was shown that this taxon has a chromosome number of 2n = 14 (Figure 7). The shortest chromosome length is 3.00 µm, the longest is 6.59 µm, and the haploid chromosome length is 35.24 µm. Of the metaphase chromosomes, 7 pairs are of the median type. Chromosome arm ratios were measured at 1.26-1.64. The centromeric index varied



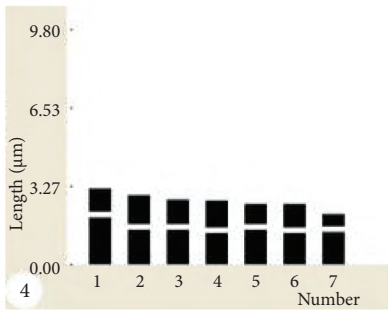
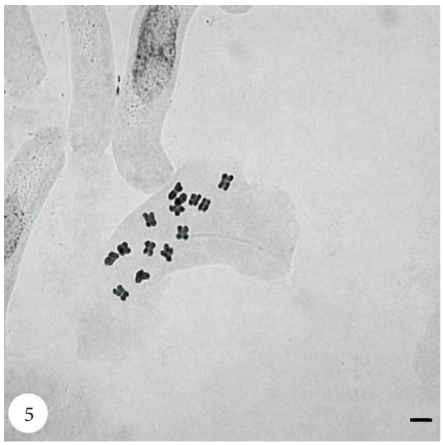


Figure 3. Somatic metaphase in *Scorzonera cana* var. *jacquiniana* (2n = 14).
Figure 4. Ideogram for *S. cana* var. *jacquiniana*, scale bars: 5 µm.



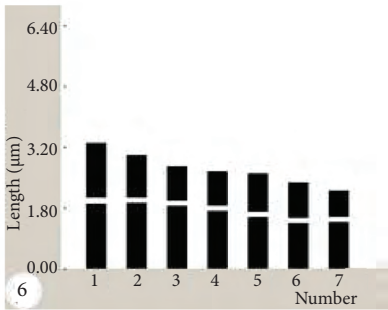


Figure 5. Somatic metaphase in *Scorzonera suberosa* subsp. *suberosa* (2n = 14).
Figure 6. Ideogram for *S. suberosa* subsp. *suberosa*, scale bars: 5 µm.

between 3.72 and 8.16, and the relative lengths varied from 8.51 to 18.70. An ideogram of the taxon was drawn using the Image Analysis System (Figure 8).

Scorzonera papposa

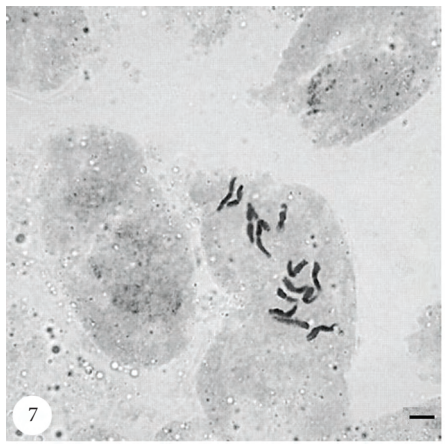
Karyotype analysis determined that this taxon has a chromosome number of 2n = 14 (Figure 9). The shortest chromosome length is 2.84 µm, the longest is 5.14 µm, and the haploid chromosome length is 28.09 µm. Of the metaphase chromosomes, 7 pairs are of the median type. Chromosome arm ratios were measured at 1.11-1.40. The centromeric index values varied between 4.22 and 8.68, and relative lengths ranged from 10.13 to 18.28. An ideogram of the taxon was drawn using the Image Analysis System (Figure 10).

Scorzonera lacera

Karyotype analysis revealed that this taxon has a chromosome number of 2n = 14 (Figure 11). The shortest chromosome length is 2.69 µm, the longest is 5.43 µm, and the haploid chromosome length is 27.49 µm. Of the metaphase chromosomes, 7 pairs are of the median type. Chromosome arm ratios were measured at 1.10-1.69. The centromeric index values varied between 3.64 and 9.02, and the relative lengths ranged from 9.79 to 19.73. An ideogram of the taxon was drawn using the Image Analysis System (Figure 12).

Scorzonera elata

Karyotype analysis determined that this taxon has a chromosome number of 2n = 14 (Figure 13). The



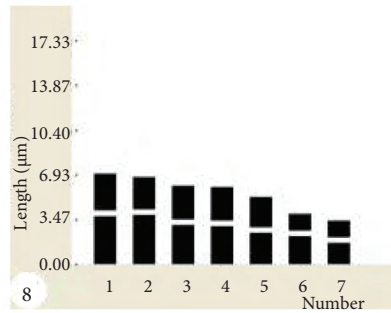
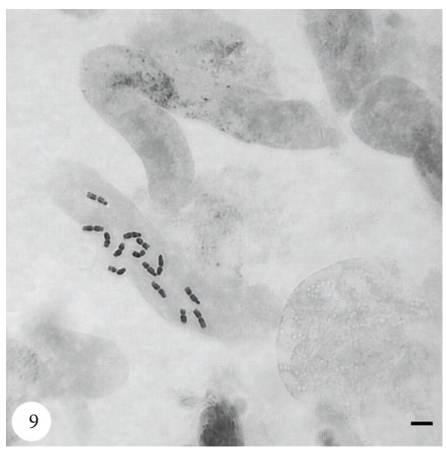


Figure 7. Somatic metaphase in *Scorzonera mollis* subsp. *mollis* (2n = 14).
Figure 8. Ideogram for *S. mollis* subsp. *mollis*, scale bars: 5 µm.



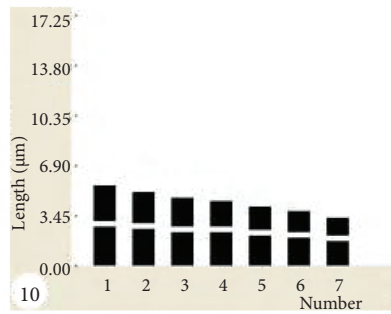


Figure 9. Somatic metaphase in *Scorzonera papposa* (2n = 14).
Figure 10. Ideogram for *S. papposa*, scale bars: 5 µm.

shortest chromosome length is 1.54 µm, the longest is 2.60 µm, and the haploid chromosome length is 13.90 µm. Of the metaphase chromosomes, 5 pairs are of the median type and 2 pairs are submedian. Chromosome arm ratios were measured at 1.13-1.78. The centromeric index values varied between 4.64 and 6.88, and relative lengths ranged from 11.04 to 18.73. An ideogram of the taxon was drawn using the Image Analysis System (Figure 14).

Scorzonera parviflora

Karyotype analysis showed that this taxon has a chromosome number of 2n = 14 (Figure 15). The shortest chromosome length is 2.16 µm, the longest is 4.39 µm, and the haploid chromosome length is 20.66 µm. Of the metaphase chromosomes, 5 pairs are of the median type and 2 pairs are submedian. Chromosome arm ratios were measured at 1.16-1.92. The centromeric index values varied between 3.94 and 9.47, and relative lengths ranged from 10.45 to 21.23. An ideogram of the taxon was drawn using the Image Analysis System (Figure 16).

Scorzonera phaeopappa

Karyotype analysis determined that this taxon has a chromosome number of 2n = 28 (Figure 17). The shortest chromosome length is 1.71 µm, the longest is 4.28 µm, and the haploid chromosome length is 38.28 µm. Of the metaphase chromosomes, 13 pairs are of the median type and 1 pair is submedian.

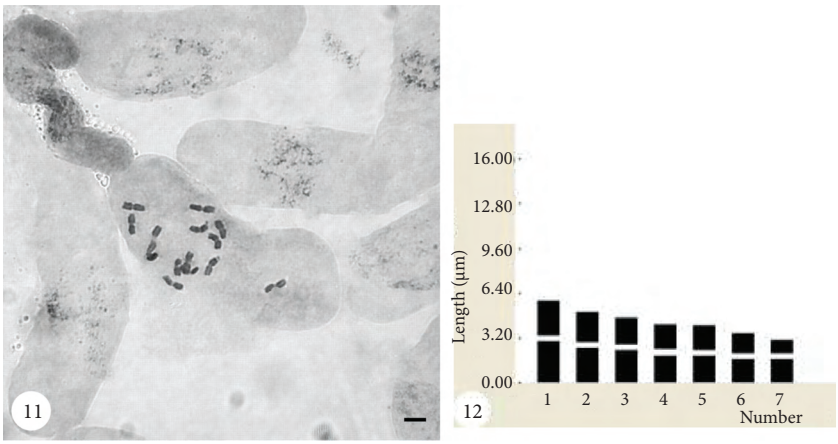


Figure 11. Somatic metaphase in *Scorzonera lacera* (2n = 14).
Figure 12. Ideogram for *S. lacera*, scale bars: 5 µm.

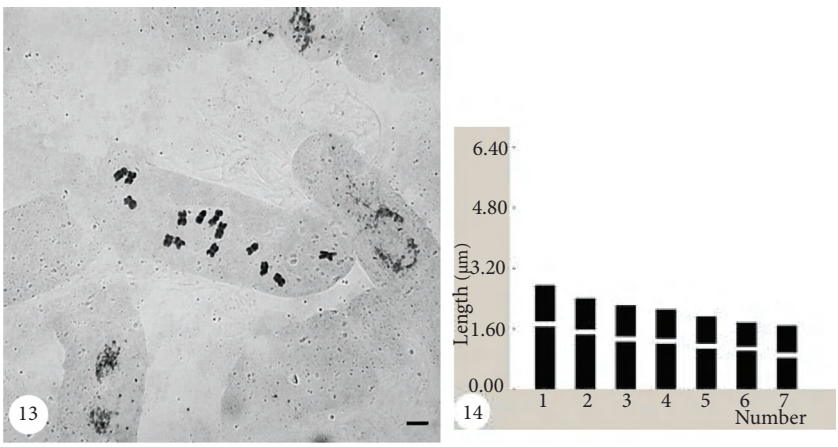


Figure 13. Somatic metaphase in *Scorzonera elata* (2n = 14).
Figure 14. Ideogram for *S. elata*, scale bars: 5 µm.

Chromosome arm ratios were measured at 1.01-1.74. The centromeric index values varied between 2.13 and 4.93, and relative lengths ranged from 4.48 to 11.17. An ideogram of the taxon was drawn using the Image Analysis System (Figure 18).

Scorzonera eriophora

Karyotype analysis determined that this taxon has a chromosome number of 2n = 12 (Figure 19). The shortest chromosome length is 4.03 µm, the longest is 7.63 µm, and the haploid chromosome length is 31.67 µm. Of the metaphase chromosomes, 5 are of the median type and 1 pair is submedian. Chromosome arm ratios were measured at 1.09-1.74. The centromeric index values varied between 5.56 and 8.79, and relative lengths ranged from 12.71 to 24.08. An ideogram of the taxon was drawn using the Image Analysis System (Figure 20).

Scorzonera pseudolanata

Karyotype analysis showed that this taxon has a chromosome number of 2n = 12 (Figure 21). The shortest chromosome length is 1.93 µm, the longest is 3.84 µm, and the haploid chromosome length is 15.63 µm. Of the metaphase chromosomes, 5 are of the median type and 1 pair is submedian. Chromosome arm ratios were measured at 1.22-1.85. The centromeric index values varied between 5.22

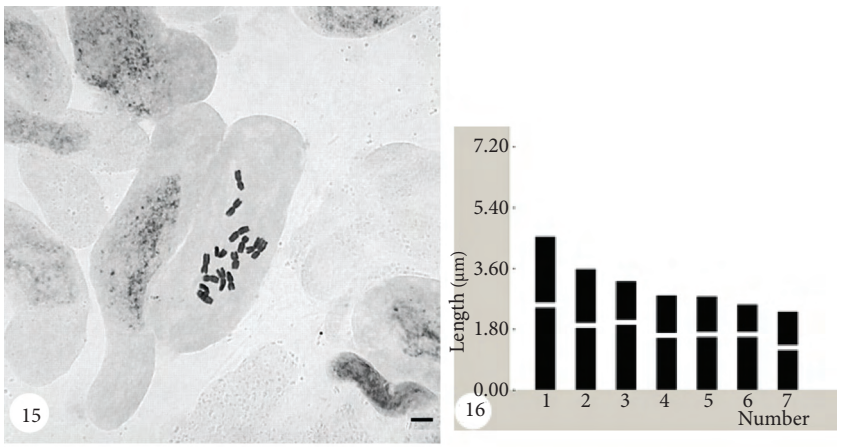


Figure 15. Somatic metaphase in *Scorzonera parviflora* (2n = 14).
Figure 16. Ideogram for *S. parviflora*, scale bars: 5 µm.

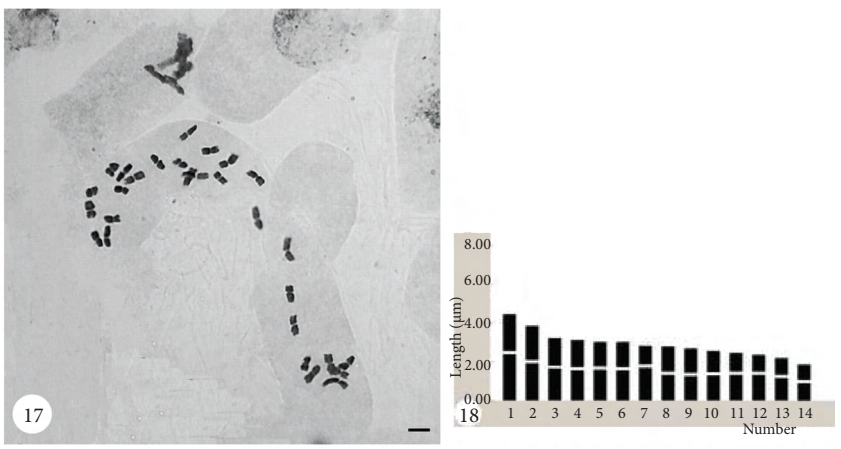


Figure 17. Somatic metaphase in *Scorzonera phaeopappa* (2n = 28).
Figure 18. Ideogram for *S. phaeopappa*, scale bars: 5 µm.

and 8.63, and relative lengths ranged from 12.35 to 24.55. An ideogram of the taxon was drawn using the Image Analysis System (Figure 22).

Scorzonera tomentosa

Karyotype analysis revealed that this taxon has a chromosome number of 2n = 12 (Figure 23). The shortest chromosome length is 1.50 µm, the longest is 2.97 µm, and the haploid chromosome length is 11.80 µm. Of the metaphase chromosomes, 3 are of the median type and 3 pairs are submedian. Chromosome arm ratios were measured at 1.11-2.03. The centromeric index values varied between 5.08 and 8.43, and relative lengths ranged from 12.71 to 25.20. An ideogram of the taxon was drawn using the Image Analysis System (Figure 24).

Scorzonera kotschyi

Karyotype analysis showed that this taxon has a chromosome number of 2n = 12 (Figure 25). The shortest chromosome length is 1.46 µm, the longest is 3.38 µm, and the haploid chromosome length is 11.84 µm. Of the metaphase chromosomes, 5 are of the median type and 1 pair is submedian. Chromosome arm ratios were measured at 1.00-1.89. The centromeric index values varied between 5.83

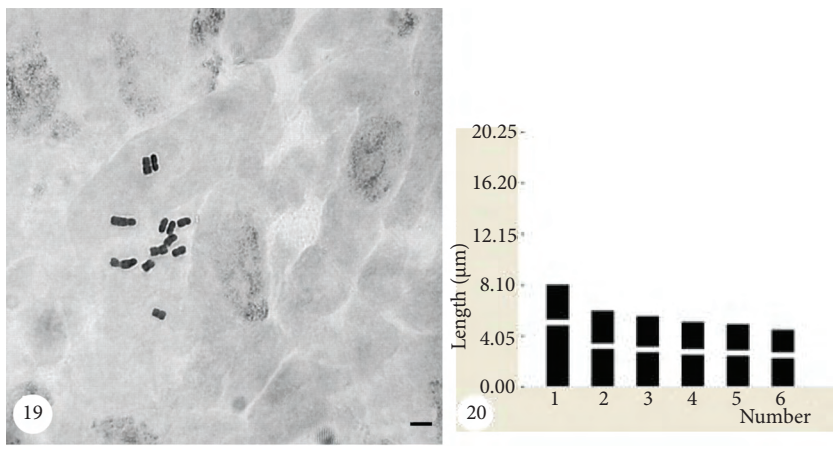


Figure 19. Somatic metaphase in *Scorzonera eriophora* (2n = 12).
Figure 20. Ideogram for *S. eriophora*, scale bars: 5 µm.

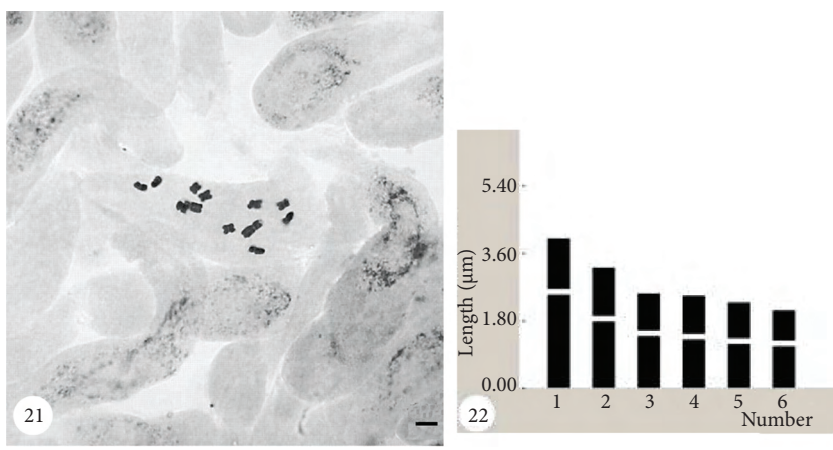


Figure 21. Somatic metaphase in *Scorzonera pseudolanata* (2n = 12).
Figure 22. Ideogram for *S. pseudolanata*, scale bars: 5 µm.

and 9.89, and relative lengths ranged from 12.33 to 28.56. An ideogram of the taxon was drawn using the Image Analysis System (Figure 26).

The localities of the studied taxa are given in Figure 27.

The taxa of the genus *Scorzonera* examined in this study have somatic chromosome numbers of 2n = 12, 2n = 14, and 2n = 28. Some of the taxa have different karyotype formulae although they have the same chromosome number. The karyotype formulae obtained were: 3m + 4sm for *Scorzonera laciniata* subsp. *laciniata*; 4m + 3sm for *S. cana* var. *jacquiniana*; 5m + 2sm for *S. suberosa* subsp. *suberosa*, *S. elata*, and *S. parviflora*; 7m for *S. mollis* subsp. *mollis*, *S. papposa*, and *S. lacera*; 13m + 1sm for *S. phaeopappa*; 5m + 1sm for *S. eriophora*, *S. pseudolanata*, and *S. kotschyi*; and 3m + 3sm for *S. tomentosa*. It has been confirmed that the chromosome morphologies among the species are specific to the taxa. Of the taxa studied, *S. laciniata* subsp. *laciniata* has the shortest chromosome length, at 1.20 µm, while *S. eriophora* has the longest chromosome length, at 7.63 µm. *S. laciniata* subsp. *laciniata* has the shortest haploid chromosome length (11.44 µm), while *S. phaeopappa*

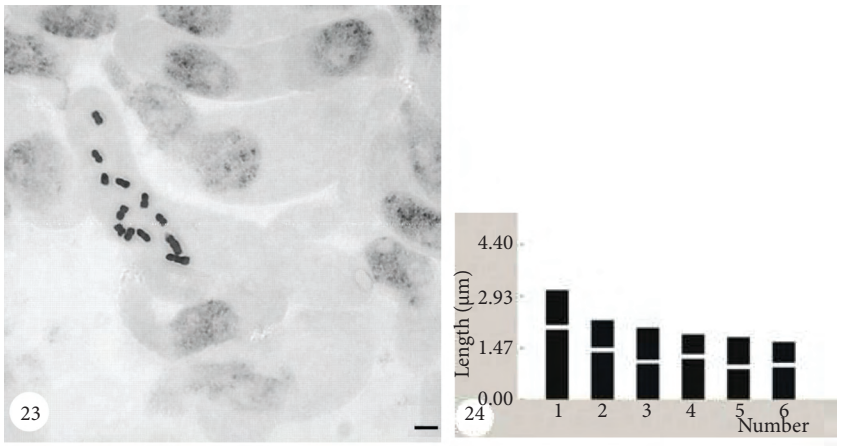


Figure 23. Somatic metaphase in *Scorzonera tomentosa* (2n = 12).
Figure 24. Ideogram for *S. tomentosa*, scale bars: 5 µm.

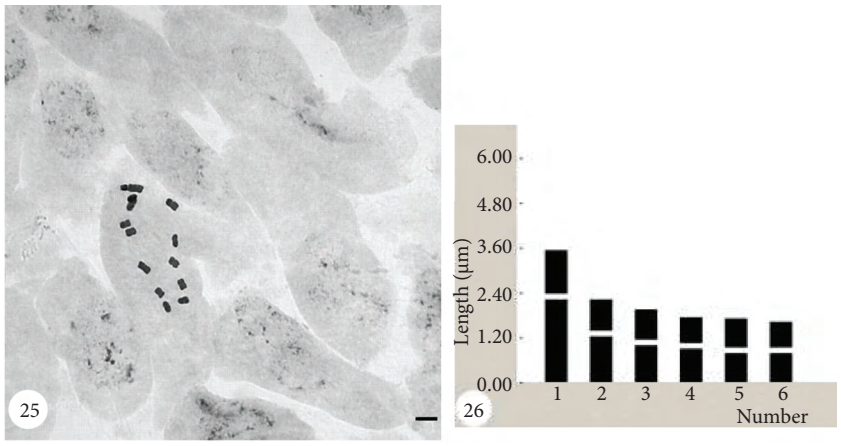


Figure 25. Somatic metaphase in *Scorzonera kotschyi* (2n = 12).
Figure 26. Ideogram for *S. kotschyi*, scale bars: 5 µm.

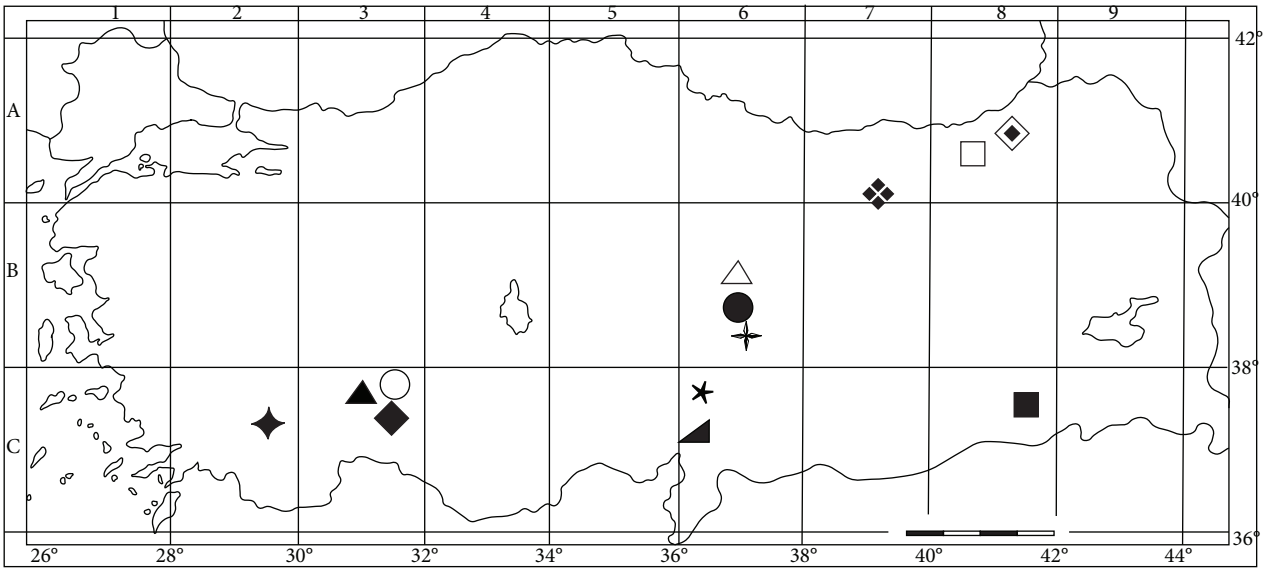


Figure 27. The localities of the studied taxa (*Scorzonera cana* var. *jacquiniana* ♦, *S. lacera* ❍, *S. eriophora* ▲, *S. suberosa* subsp. *suberosa* ●, *S. pseudolanata* Δ, *S. parviflora* ✧, *S. papposa* ■, *S. elata* ✦, *S. kotschyi* ✻, *S. phaeopappa* ◢ , *S. mollis* subsp. *mollis* ❖, *S. laciniata* subsp. *laciniata* □, *S. tomentosa* ◪).

has the longest (38.28 μm). Considering the arm ratios, the lowest value was obtained from *S. kotschyi* (1.00), and the highest from *S. laciniata* subsp. *laciniata* (2.73). *S. lacera* has the lowest centromeric index (3.64), while *S. kotschyi* has the highest (9.89). In terms of relative length, *S. phaeopappa* has the lowest value (4.48), while *S. kotschyi* has the highest (28.56).

The genus *Scorzonera* growing in the Iberian Peninsula was revised. In the revision, it was stated that the genus *Scorzonera* consists of 3 subgenera, 3 sections, 10 species, and 14 varieties. Chromosome numbers of the taxa were presented in the revision, showing that the genus *Scorzonera* has 2 different main chromosome numbers, n = 6 and n = 7. Diploid chromosome numbers were reported as 2n = 12 and 2n = 14 (26-28). Data obtained from our study is in agreement with this literature.

In a karyosystematic study of the genus *Scorzonera*, the somatic chromosome number was found to be 2n = 12 for the species *S. rigida* and 2n = 14 for *S. pygmaea* (28). In our study, no variation was observed in terms of the somatic chromosome numbers of the taxa of *Scorzonera*.

In a karyological study examining chromosome numbers of the rare plants of Romania, *Scorzonera purpurea* L. subsp. *rosea* (Waldst. & Kit.) Nyman was reported to have a main chromosome number of n = 7 and a diploid chromosome number of 2n = 14 (29). In our own study, 9 taxa of the genus *Scorzonera* had a diploid chromosome number of 2n = 14, which is in agreement with the literature.

It was stated in a cytological study that *Scorzonera humilis* L. has a somatic chromosome number of 2n = 14 (30). In a karyological study on plants growing naturally in Spain, the somatic chromosome number of the species *S. hirsuta* was reported to be 2n = 12 (31). There were 2 species of the genus *Scorzonera* included in a study determining the chromosome numbers of 48 genera and 82 taxa of the family Compositae growing in Pakistan. That work showed that both species, *S. koelpinioides* and *S. tortuosissima*, have the same chromosome number, 2n = 28 (32). In a different cytological study, the diploid chromosome number of the taxa *Scorzonera austriaca* Willd., *S. hispanica* L., *S. humilis* L., *S. laciniata* L., and *S. parviflora* Jacq. was reported to be 2n = 14. Of these taxa, *S. laciniata* and *S. parviflora* were also included in our study; the somatic chromosome

number obtained from our study was found to be in agreement with the literature.

In cytogenetic terms, taxa of the genus *Scorzonera* have been insufficiently studied. Askerova (1987) revealed that there is a close relationship among the genera *Scorzonera* L., *Podospermum* DC., *Epilasia* Benth., *Tourneuxia* Cass., *Pterachaenia* Lipsch., and *Takhtajantha* Nazarova. Askerova further stated that the main chromosome number of these groups varies between n = 6 and n = 7. Some discrepancies among species of *S. cana* (C.A.Mey.) Hoffm. and *S. rosea* Waldst. & Kit. were reported in a karyological study of the genus *Scorzonera*. It was reported that these discrepancies might result from the fact that the species *S. cana* belongs to a different subgenus (34,35).

Similar studies have been carried out by this system previously. The diploid chromosome number of the species *S. argyria* was found to be 2n = 12. The total chromosome lengths vary between 3.52 and 8.36 mm, while the arm ratios range from 1.28 to 1.87 mm. The karyotype formula consists of 5 median chromosome pairs and a submedian chromosome pair. The total haploid chromosome length was given as 31.07 mm (36). Comparing these results with those obtained in our study, the karyotype formulae of the taxa *S. eriophora*, *S. pseudolanata*, and *S. kotschyi* are the same, but they differ with regard to their chromosome measurements. Thus, the closest value for *S. argyria* was obtained from *S. eriophora*.

In a different study in which some taxa of the genera *Scorzonera* and *Podospermum* (Asteraceae) were examined in order to clarify their cytological and molecular characteristics, the somatic chromosome numbers of the taxa were determined to be 2n = 12 and 2n = 14 (37).

In a karyotype analysis of some *Scorzonera* species, the results were reported as follows: *S. purpurea* L., K (2n) = 14 = 8 A^m + 6 B^{sm} and K (2n) = 14 + 1 = 9 A^m + 6 B^{sm}; *S. austriaca* Willd., K (2n) = 14 = 6 A^m + 6 B^{sm} + 2 C^{st}; *S. humilis* L., K (2n) = 14 = 12 A^m + 2 B^{sm}; *S. parviflora* Jacq., K (2n) = 14 = 10 A^m + 4 B^{sm}; and *S. hispanica* L., K (2n) = 12 A^m + 2 B^{sm} (38). Of these, our study includes only the species *S. parviflora*, whose karyotype formula was the same in the results of both studies.

A review of the literature indicates that only the chromosome numbers have been counted for the taxa *Scorzonera cana*, *S. mollis*, *S. parviflora*, *S. lacera*, *S. phaeopappa*, *S. pseudolanata*, and *S. suberosa*; karyotype analyses of those taxa were not previously available (39). Therefore, with the exception of *S. parviflora*, the chromosome morphologies of these taxa are presented here for the first time.

The karyological characteristics of the taxa *Scorzonera laciniata* subsp. *laciniata*, *S. cana* var. *jacquiniana*, *S. parviflora*, *S. kotschyi*, *S. tomentosa*, *S. incisa*, and *S. eriophora* growing naturally in Turkey were reported (40-43).

In the present study, chromosome numbers of 13 *Scorzonera* taxa from the family of Asteraceae are defined for the first time. This study could play a positive role in clarifying the morphologically unsolved problems of this taxonomically complex genus.

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