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Chromosome number and karyomorphologic studies of endemic *Astragalus victoriae* Podlech & Kirchhoff

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Abstract

This paper is the first report known concerning with chromosome number and morphology of *Astragalus victoriae* Podlech & Kirchhoff in Turkey. Karyomorphological analyses includes the chromosome length, centromer position, the arms rates (short/long) and asymmetry indices. In the analyses, the chromosome number of *A. victoriae* was determined as 2n = 2x = 16 and this data was consistent with the suggested chromosomal counts in Index to Plant Chromosome Numbers (IPCN) for the genus. The karyotype of *A. victoriae* consists of metacentric and submetacentric chromosomes and the species is seen fairly different from in points of chromosome lengths (CV_{CL}: 30.774). The chromosome formula has been determined as 2sm+14m and the species consists of symmetric chromosomes (AI: 2.958, CI: 46).

Key words: *Astragalus victoriae*, endemic, chromosome numbers, karyomorphology, Turkey

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Endemik *Astragalus victoriae* Podlech & Kirchhoff Türünün kromozom sayı ve karyomorfolojik çalışmaları

Özet

Bu makale, Türkiye'de *Astragalus victoriae* Podlech & Kirchhoff türünün kromozom sayısı ve morfolojisi ile ilgili bilinen ilk rapordur. Karyomorfolojik analizler kromozom uzunluğu, sentromer pozisyonu, kol oranları (kısa/uzun) ve asimetri indekslerinin belirlenmesini içermektedir. Analizlerde, diploid kromozom sayısı 2n = 2x = 16 olarak belirlenmiş ve bu veri bitki kromozom sayı indeksinde (IPCN) cins için önerilen temel kromozom sayısı ile tutarlıdır. *A. victoriae*'nin karyotipi, metasentrik ve submetacentrik kromozomlardan oluşur ve bu tür kromozom uzunlukları açısından oldukça farklı görünür (CV_{CL}: 30.774). Kromozom formülü 2sm+14 m olarak belirlenmiş olup, kullanılan kromozom indekslerine göre tür simetrik kromozomlardan oluşmaktadır (AI: 2.958, CI: 46).

Anahtar kelimeler: endemik, kromozom sayımları, karyomorfoloji, Türkiye

1. Introduction

Astragalus L. is one of the largest genera of angiosperms. While the genus is represented with 2500-3000 taxon in the world [1], it includes 476 taxa in Turkey and almost 203 of them are endemic [2, 3]. The endemism rate is approximately 42 %. Turkey is one of the main centre of diversity for the genus *Astragalus* [4]. Many *Astragalus* species have economic and medical value as well as use to prevent erosion [5, 6, 7] and these increase the taxonomical importance of the genus. Because of these cases, many studies in scope of systematic, karyology, anatomy and palinology had been performed on *Astragalus* species. Despite all this work, some taxonomic problems stay still not fully resolved in the genus [8, 9, 10]. Numerous cytological studies have been conducted on *Astragalus* species and the basic chromosome numbers of the genus has been reported as x = 6, 7, 8, 9, 11, 15 [11, 12, 13, 14, 15]. Especially, it has been reported that the basic chromosome number is always x = 8 for Older World species such as *Astragalus victoriae* [16]. The aim of this study was to determine the chromosome number and karyomorphology of *Astragalus victoriae* Podlech & Kirchhoff that is an endemic species of Turkey.

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2. Materials and methods

Astragalus victoriae was collected from Konya Province (Karapınar erosion prevention area, 1050 m, *K. Ertuğrul* 2764, 18 v 2013). Mature seeds were germinated and chromosome counts were counted in somatic metaphase by crushing technique [17]. The root tips of the germinated seeds were treated with 8-hydroxyquinoline at 4°C for eight hours. The material was fixed for 24 hours with a Carnoy's fixative at low temperature. Then, the material was hydrolyzed with 5 N HCl for one hour at room temperature. The material was stained with 1% aceto-orcein. After obtaining the appropriate metaphase, the images of the chromosomes were taken with the Olympus DP72 digital camera mounted on an Olympus BX53 microscope. Karyotype measurements and symmetry indexes of the examined samples were calculated by using KAMERAM program.

3. Results and discussion

Astragalus victoriae Podlech & Kirchhoff

According to Index to Plant Chromosome Numbers, the chromosome number and morphology for *A. victoria* were determined for the first time in here. The chromosome number is counted as 2n = 16 and the species is a diploid. Thus, the basic chromosome number of the species is x = 8 (Table 1, Figure 1). According to literatures [18, 19, 20], all of the *Astragalus* species in New World have aneuploid chromosome numbers (x = 11-15). However, most of the species in old world are euploid (x = 8). Badr et al. [21] indicated that the x = 7 and x= 6 numbers had been derived from x = 8 by descending aneuploidy. Although Ekici et al. [22] reported that the basic chromosome number of all section species in Turkey is *x* = 8, Martin et al. [14] notified that the basic numbers in *A. hymenocystis* is x=9. This basic number was firstly given for the genus of the World. The basic chromosome number (x=8) observed in our study is in compatible with previous reports which is given for all Older World. According to karyotype analysis, *A. victoriae* includes seven metacentric and one submetacentric chromosome and has a satellite on the long arm of the largest chromosome. The total haploid chromosome length (TCL) was 12.068 µm (Table 1). The sizes of the chromosomes are gradually decreased except for one chromosome pair (Table 1) and its mean chromosome length ranges from 1.04 to 2.60 µm. Dopchiz et al. [16] reported that most of chromosomes are short, with arms more or less equal in length, but one pair is usually much longer. Their report is congruent with our results. Lima De Faria [23] the chromosome length varied from 4 to 12 µm and evaluated chromosomes as medium size. Since the mean chromosome length of *A. victoriae* is 1.51, it could be deduced that *A. victoriae* had very small chromosomes with comparing to Lima De Faria's values.

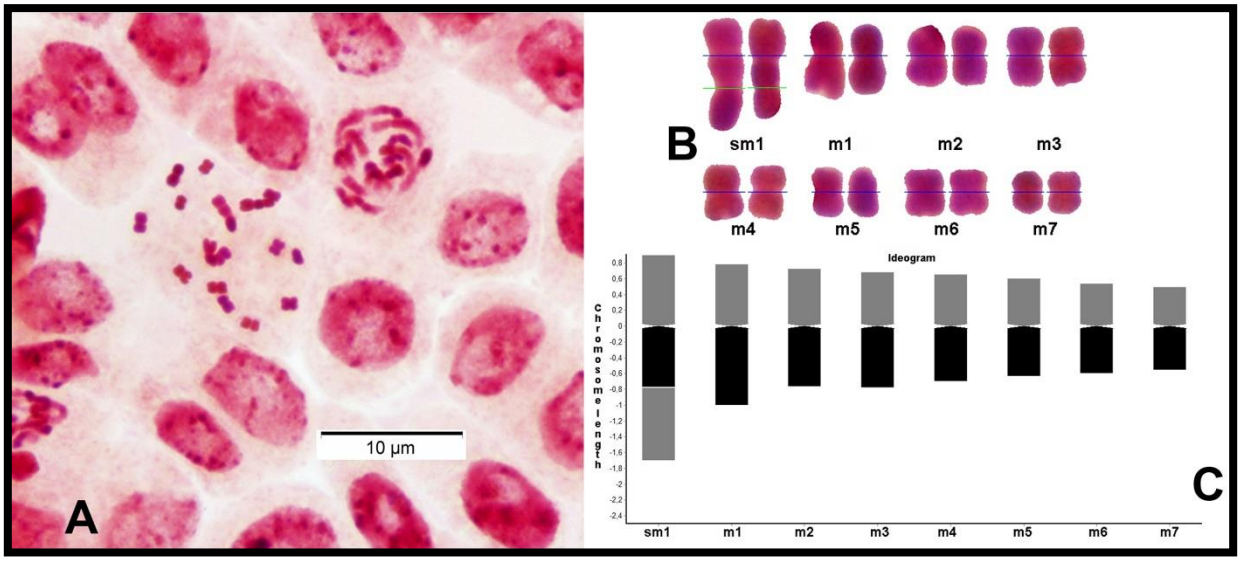

Figure 1. Karyomorphology of *Astragalus victoriae*, with 2*n* = 16. A-Metaphase plate, B-Karyogram, C-Ideogram

Table 1**.** The chromosome properties of *Astragalus victoriae*. R: Range, LC:Longest chromosome length, SC:Shortest chromosome length, p:Mean length of the long short arm, q:Mean length of the long arm, CL:Mean chromosome length, TCL:Total haploid complement length, CI:mean centromeric index, CF:Chromosome formula, m:metacentric, sm:submetacentric

Species	**2n**	**R SC-LC (µm)**	**R- LC / SC**	**p (µm) mean (±SD)**	**q (µm) mean (±SD)**	**CL(µm) mean (±SD)**	**TCL (µm)**	**CI mean (±SD)**	**CF**
Astragalus victoriae	16	1.04 – 2.60	2.489	0.67 (±0.12)	0.84 (±0.35)	1.51 (±0.46)	12.06 8	46 (±0.04)	2sm + 14m
Total size of *Astragalus victoriae*: sm1: 5.192, m1: 3.562, m2: 2.97 m3: 2.913 m4: 2.695 m5: 2.456 m6: 2.262 m7: 2.086									

The asymmetry indices have been determined as 0.152, 0.308 and 2.9 for A_1, A_2 and AI, respectively and thanks to these findings, it could be said that karyotype is rather symmetrical. Other asymmetry indices and values are given in Table 2. Konichenko et al. [24] reported that *A. sericeocanus* has symmetrical karyotype in which value was A_1:0.33 according to intrachromosomal symmetry index. As a result of the obtaining values, we can say that *A. victoriae* (A_1: 0.152) has also symmetrical karyotype. Additionally, Baziz et al. [25] emphasize that *Astragalus armatus* spp are characterized with symmetrical karyotypes due to predominance of metacentric chromosomes and symmetrical karyotypes seems to be a common trait in the genus except for exceptions. Since the rate of metacentric chromosomes were quite high in the karyotypes of *A. victoriae* such as other *Astragalus* taxa reported in here, it could be proposed that a disposition towards symmetrical karyotypes exists in this species, indicating an ancestral character as in *Aristolochia* [26].

Table 2. Assymetry indices of *Astragalus victoriae*. A_1:Intrachromosomal asymmetry index, A_2:Interchromosomal asymmetry index, CV_{CL}:Coefficient of variation of chromosome length, CV_{CI}: Coefficient of variation of centromeric index, AI:Karyotype asymmetry index

Species	**A_1**	**A_2**	**CV_{CL}**	**CV_{CI}**	**AI**
Astragalus victoriae	0.152	0.308	30.774	9.612	2.958

In conclusion, this study focused on the chromosome number and morphology of endemic *Astragalus victoriae* species. Karyological studies within the genus *Astragalus* of these karyomorphological findings will expected to make great contributes.

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