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CYTOGENETICAL ANALYSIS OF 12 TAXA OF *GENISTA* L. (FABACEAE) FROM TURKEY

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Abstract

In this study, cytogenetical analyses of 12 taxa belonging to the genus *Genista* L. and grown naturally in Turkey were conducted. These taxa include *G. acanthoclada*, *G. albida*, *G. anatolica*, *G. aucheri*, *G. burdurensis*, *G. carinalis*, *G. involucrata*, *G. januensis* subsp. *lydia*, *G. sandrasica*, *G. sessilifolia*, *G. tinctoria* and *G. vuralii*. Chromosome numbers of all the taxa, except *G. tinctoria*, are introduced to the scientific community for the first time. Somatic metaphase chromosomes of the genus were determined as 2n = 18, 36, 46, 48, 52, 72 and 144. Polyploidy was observed in the cells of *G. albida* (2n = 18, 2n = 4x = 36), *G. tinctoria* (2n = 36, 48, 2n = 4x = 96), *G. januensis* subsp. *lydia* (2n = 46, 2n = 4x = 92), *G. burdurensis* and *G. sessilifolia* (2n = 48, 2n = 4x = 96). Somatic chromosomes of the *G. sandrasica* are very small, thus exact ploidy level of polyploidy was not determined. Karyotype analysis of *G. albida* and *G. involucrata* were performed via an Image Analysis System.

Introduction

Fabaceae (Leguminosae) is a large family represented by 650 genera and 18,000 species in the world (Kass and Wink, 1997). Except for Antarctica, taxa of Fabaceae may be found from herbaceous to shrubby forms in all continents. Fabaceae in Anatolia consisted of 974 species belonging to 69 genera (Davis *et al*., 1988) of Mimosoideae, Caesalpinioideae and Papilionoideae subfamilies. The genus *Genista* L. falls under the subfamily Papilionoideae which is made up of about 90 species in the world (Hickey and King, 1997; Duran and Dural, 2003).

Genista is distributed in the phytogeographic regions of Mediterranean and the related European, North African and West Asian territories (Hickey and King, 1997). It is widely accepted as a genus with Mediterranean origin. All of its species are perennial shrubby and short woody forms. In Turkey, the genus is specifically prevalent at the Mediterranean phytogeographic region, but is also pervasive at the transition zones of Mediteranean-Irano-Turanian as well as the Mediteranean-Euro-Siberian regions. Restricted distribution of *Genista* is also seen in the Eastern and South-Eastern Anatolia. *Genista* in Turkey is represented by 15 taxa, 14 species and one variety, and five species, namely *G. aucheri*, *G. burdurensis*, *G. involucrata*, *G. sandrasica* and *G. vuralii* are endemic to Turkey (Gibbs, 1970; Davis *et al*., 1988; Duran and Dural, 2003).

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Karyotypical knowledge needs to be used in conjunction with other sources of data to achieve a better understanding of the cytologic relationship of *Genista* taxa, leading to their natural classification. In this regard, the numbers of somatic chromosomes were determined in 12 taxa of *Genista* growing naturally in Turkey, and karyological attributes of selected taxa were evaluated for the first time.

Materials and Methods

Voucher specimens have been deposited at the herbarium of Selcuk University, Faculty of Education, Konya, Turkey (Table 1). Chromosome numbers and karyotypes were made on somatic metaphases using the squash technique. Root meristems from germinating seeds collected in the wild were used. Root tips were pretreated with α-monobromonaphthalene at 4°C for 16 h. Root tips were fixed with Carnoy for 24 h at 4°C. Before staining, the material was hydrolyzed with 1N HCl for 13 minutes at room

Table 1. Localities and other information on specimens of 12 *Genista* taxa studied.

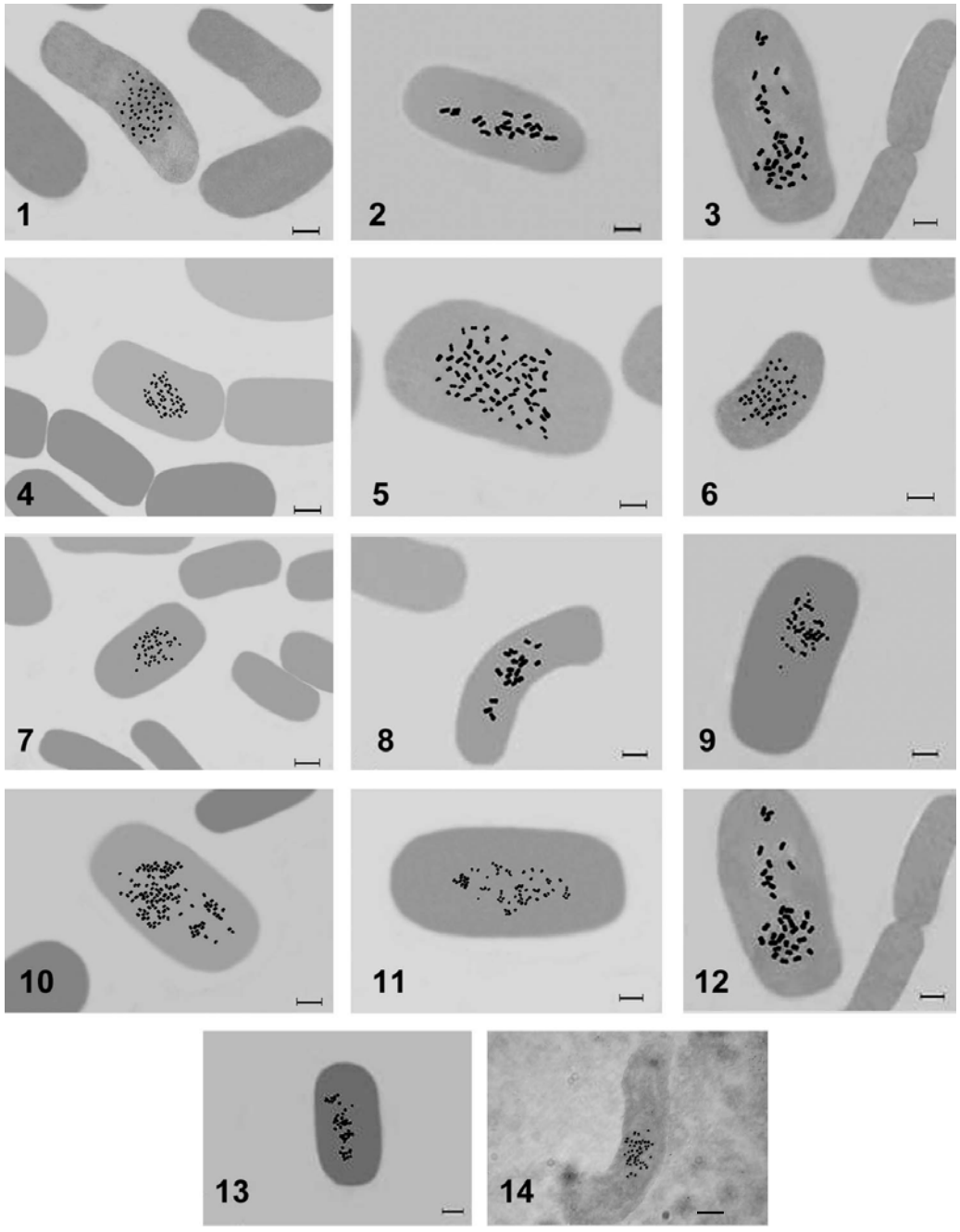
Taxon	Locality of voucher specimens
G. acanthoclada DC.	Mugla: Eski Kale road, 900 m, scrubby region, 23.07.2006, A. Duran 7309.
G. albida Willd.	Burdur: Dirmil passage, preserved area, open spaces, 1630 m, 25.07.2006, A. Duran 7331.
G. anatolica Boiss.	Osmaniye: Amanos Mountains, Mitisin plateau, open *Pinus nigra* forest, 1350 m, 04.07.2006, M. Dinc 2702.
G. aucheri Boiss.	Sivas: Sivas-Zara interim, 5 km before Zara, steppe, 1350 m, 26.07.2006, M. Dinc & A. Duran 2811.
G. burdurensis P. Gibbs	Burdur: Tefenni-Yesilova road, Karamanli exit, surrounding dam, *Quercus* vacancy, 1200 m, 25.07.2006, A. Duran 7336.
G. carinalis Gris.	Balıkesir: Edremit, from Kızılkecili village at Kaz Dagi, Gölcük location, *Pinus nigra* and *Quercus* forest, 400 m, 22.07.2006, A. Duran 7302.
G. involucrata Spach	Sivas: Akdagmadeni–Yıldızeli interval, *Quercus* distinction, 25th km, 1275 m, 26.07.2006, M. Dinc & A. Duran 2808.
G. januensis Viv. subsp. *lydia* (Boiss.) Kit Tan & Zieliński	Osmaniye: Zorkun plateau, Kadirli peak, Cevizli region, *Pinus nigra* forest, 1500 m, 14.07.2006, M. Dinc 2786.
G. sandrasica Hartwig & Strid.	Mugla: Köycegiz, Sandras Mountain, *Pinus nigra* forest, 1700 m, 14.08.2007, M. Dinc & S. Dogu 3062.
G. sessilifolia DC.	Kırsehir: Sereflikochisar-Karaman road, 5 km before Karaman, step, 1000 m, 26.07.2006, M. Dinc & A. Duran 2810.
G. tinctoria L.	Erzincan: Refahiye İlic road (7th km), steppe, 1740 m, 28.07.2006, M. Dinc & A. Duran 2844.
G. vuralii A. Duran & H. Dural	Cankırı: Ilgaz Mountain, Telekom transmitter vicinity, 1900 m, A. Duran 8143.

temperature. It was stained with 2% acetic orcein and mounted in 45% acetic acid. For all the counts, a minimum of ten plates from different individuals were examined and for each taxa only one population was studied. Permanent slides were made by using the standard liquid nitrogen method. Photographs were taken through BX50 Olympus microscope. The ideogram was prepared with measurements taken on enlarged micrographs of five well-spread metaphase plates. The karyotypes, the lengths of long and short arms, arm ratio, centromeric index, and relative chromosomal length were measured by Image Analysis System (Bs200Pro) loaded on a personal computer. At least five metaphase plates were measured for *G. albida* and *G. involucrata*. Chromosomes were classified using the nomenclature of Levan *et al*. (1964).

Results and Discussion

According to the cytogenetical data analyses of *Genista*, the somatical chromosome numbers of the studied taxa are highly divergent (ranging from 2n = 18, 36, 46, 48, 72 to 144) (Figs 1-14). The numbers of chromosomes were determined within *G. albida* and *G. involucrata* (2n = 18), *G. albida* and *G. tinctoria* (2n = 36), *G. carinalis* and *G. januensis* subsp. *lydia* (2n = 46), *G. anatolica*, *G. burdurensis*, *G. sessilifolia*, *G. tinctoria* and *G. vuralii* (2n = 48), *G. acanthoclada* (2n = 52), *G. aucheri* (2n = 72), and *G. sandrasica* (2n = 144). Although rare, a few cells revealed polyploidy in some of preparates (*G. albida*, *G. burdurensis*, *G. januensis* subsp. *lydia*, *G. sandrasica*, *G. sessilifolia* and *Genista tinctoria*). The numbers of chromosomes were determined in *Genista albida* (2n = 18, 2n = 4x = 36), *G. tinctoria* (2n = 36, 48, 2n = 4x = 96), *G. januensis* subsp. *lydia* (2n = 46, 2n = 4x = 92), and *G. burdurensis* and *G. sessilifolia* (2n = 48, 2n = 4x = 96). Tetraploid cells were determined in the same preparates where diploid chromosomes were counted. However, the somatic chromosome of the *G. sandrasica* is very small and it was difficult to determine the exact ploidy level of polyploidy.

Additionally, karyotype analyses of *G. albida* and *G. involucrata* were conducted by using an Image Analysis System (IAS) (Figs 15-16). The basic chromosome number of these species were x = 9. While chromosome morphology of *G. albida* was 9m, that of *G. involucrata* was determined as 8m+1sm. Total haploid chromosome size of *G. albida* was greater (19.59 µm) when compared with *G. involucrata* (18.08 µm). The length of chromosomes were measured between 1.55 and 3.19 µm within the species *G. albida*, while it was 1.35-2.69 µm in *G. involucrata*. Chromosomal arm ratios differed in *G. albida* (1.13-1.65) from that of *G. involucrata* (1.09-1.94). From the cytological results, however, it was understood that, taxonomically, it is not appropriate to classify these two species since they have the same chromosome numbers and very similar karyotypes. Therefore, karyological features obtained in this study were not enough to classify these two species.



Figs 1-14. Metaphase chromosomes in study taxa. 1. *G. acanthoclada* 2n = 52, 2. *G. albida* 2n = 18, 3. *G. albida* 2n = 36, 4. *G. anatolica* 2n = 48, 5. *G. aucheri* 2n = 72, 6. *G. burdurensis* 2n = 48, 7. *G. carinalis* 2n = 46, 8. *G. involucrata* 2n = 18, 9. *G. januensis* subsp. *lydia* 2n = 46, 10. *G. sandrasica* 2n = 144, 11. *G. sessilifolia* 2n = 48, 12. *G. tinctoria* 2n = 36, 13. *G. tinctoria* 2n = 48, 14. *G. vuralii* 2n = 48. (Bars = 5 μm)

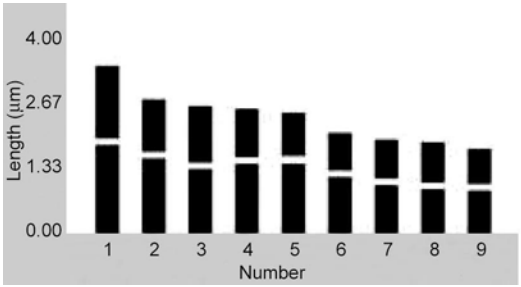


Fig. 15. Ideogram of *Genista albida*.

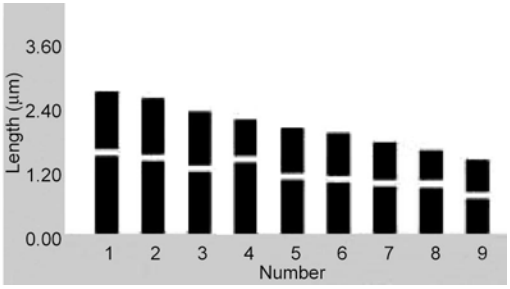


Fig. 16. Ideogram of *Genista involucrata*.

Karyological studies of *Genista* taxa distributed in the Balkan Peninsula were previously performed by Cubas *et al*. (1998) in order to resolve the genetic evolution of the taxa. In their study, they also used some species that are distributed in Anatolia and determined their chromosome numbers. These taxa included *G. carpetana* subsp. *carpetana* (2n = 40), *G. cinerascens* (2n = 24), *G. micrantha* (2*n* = 36), *G. mugronensis* subsp. *rigidissima* (2n = 36), *G. ramosissima* (2n = 48), and *G. tinctoria* (2n = 48). In their study, novel aneuploid chromosome number for *G. florida* (x = 23) as well as polyploidy (2n = 64) for *G. tournefortii* subsp. *tournefortii* were also determined. They also emphasized the need for further chromosomal data in order to clarify the cytological differentiation within the genus *Genista*. Two somatic chromosome numbers of *G. tinctoria* (2n = 36 and 48) are determined in the present study differing from Cubas *et al*. (1998). It is possible to consider *G. tinctoria* having different somatic chromosome numbers. These cytogenetic diversions may have an effect on the distinct occurrence of infraspecific variation.

The present study effectively determined the chromosome numbers and karyotypical characteristics of 12 *Genista* taxa that are naturally distributed in Turkey. This study expanded the range of chromosomal number in *Genista* and also recorded the karyological features of two *Genista* species.

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