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Chromosome studies in the Greek flora III. Karyotypes of eight Aegean species

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Abstract

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Chromosome numbers and descriptions of the chromosome morphology are given for eight Aegean taxa of the Greek flora. Three of them viz. *Anthemis glaberrima* (2n = 18), *Gynara cornigera* (2n = 34) and *Bellevalia brevibedicellata* (2n = 8) are Aegean endemics and their caryotypes are given for the first time. The five remaining are widespread in the Mediterranean basin but Aegean material has never been cytologically investigated before.

Introduction

This paper, the third of a series (Tzanoudakis 1986a & b) deals also with the cytological study of some Aegean species. The taxa included are either endemics in the Aegean area or show a scattered distribution in the entire Mediterranean basin and therefore, all are interesting from a phytogeographical point of view.

Material and methods

All the material investigated is of wild origin. Rhizomes, bulbs or seeds have been collected by the authors and cultivated at the Botanical Institute of the University of Patras. Information concerning the origin of the material is given in Table 1 and voucher specimens are deposited in the Botanical Museum of the University of Patras (UPA).

The taxonomy of the material and the distribution area of the taxa are in accordance with Flora Europea (Tutin et al. 1964–1980). For the study of the karyotypes, root tips from potted material were used.

The cytological techniques and the methods of karyotype analysis have been described in the first paper of the series (Tzanoudakis 1986a).

Table 1. Chromosome numbers and origin of the material

Taxon	Distribution	Origin of the material	2n
Campanula trichocalycina Ten.	Al, Bu, Cr, Gr, It, Ju, Si	Crete: Chania, Lefka Ori ca 1800 m.	32
Anthemis glaberrima (Rech. fil). W. Greuter	Cr	Crete: Chania, Islet of Agria Gramvousa	18
Gynara cornigera Lindley	Cr, Gr	Crete: Chania, Islet of Hymeri Gramvousa	34
Gynara cornigera Lindley		Dodekannisos: Astypalea	34
Hyoseris radiata L.	Bl, Co, Cr, Ga, Gr, Hs, It, Ju, Lu, Sa, Si, Tu	Cyclades: Island Heraklia	16
Hyoseris radiata L.		Cyclades: Islet of Ophidouses	16
Hyoseris radiata L.		Crete: Chania, Islet of Hymeri Gramvousa	16
Hyoseris scabra L.	Bl, Co, Cr, Ga, Gr, Hs, It, Ju, Lu, Sa, Si, Tu	Crete: Chania, Gorge of Asphendou	16
Asphodeline liburnica (L.) Reichenb.	Al, Bu, Cr, Gr, It, Ju, Tu	Crete: Chania, Gorge of Therissos	28
Asphodeline lutea (Scop.) Reichenb.	Al, Bu, Cr, Gr, It, Ju	Crete: Rethymno, Gorge of Kourtalioti	28
Bellevalia brevipedicellata Turril	Cr	Crete: Chania, Chryssos-kalitisa	8

Results

Material from eleven populations belonging to 8 taxa has been studied and the chromosome numbers obtained are summarized in Table 1. Aegean material of these taxa has never been investigated before, from a cytological point of view. The chromosome number of the three regional endemics, viz. *Anthemis graberrima, Cynara cornigera* and *Bellevalia brevipedicellata* are given for the first time. The karyotypes of these endemic taxa and those of *Hyoseris radiata, H. scabra* and *Asphodelina liburnica* have been studied in more detail and karyograms and/or idiograms are given (Fig. 1–3). The main cytological and phytogeographical remarks are given and discussed in independent subheadings.

Campanula trichocalycina Ten. (2n = 32)

This species shows a scattered distribution in the Mediterranean basin, known from some European countries, (Tutin et al. 1976) but also from North Africa and Asia Minor (Contadriopoulos 1966).

The species seems to be very rare in Greece; yet two populations have recently been found and investigated cytologically. One from Northern Greece (Contadriopoulos 1966) and one from Crete which being studied by the authors. In both a chromosome number of 2n = 32 was found. Any suggestion, however, concerning the origin of this

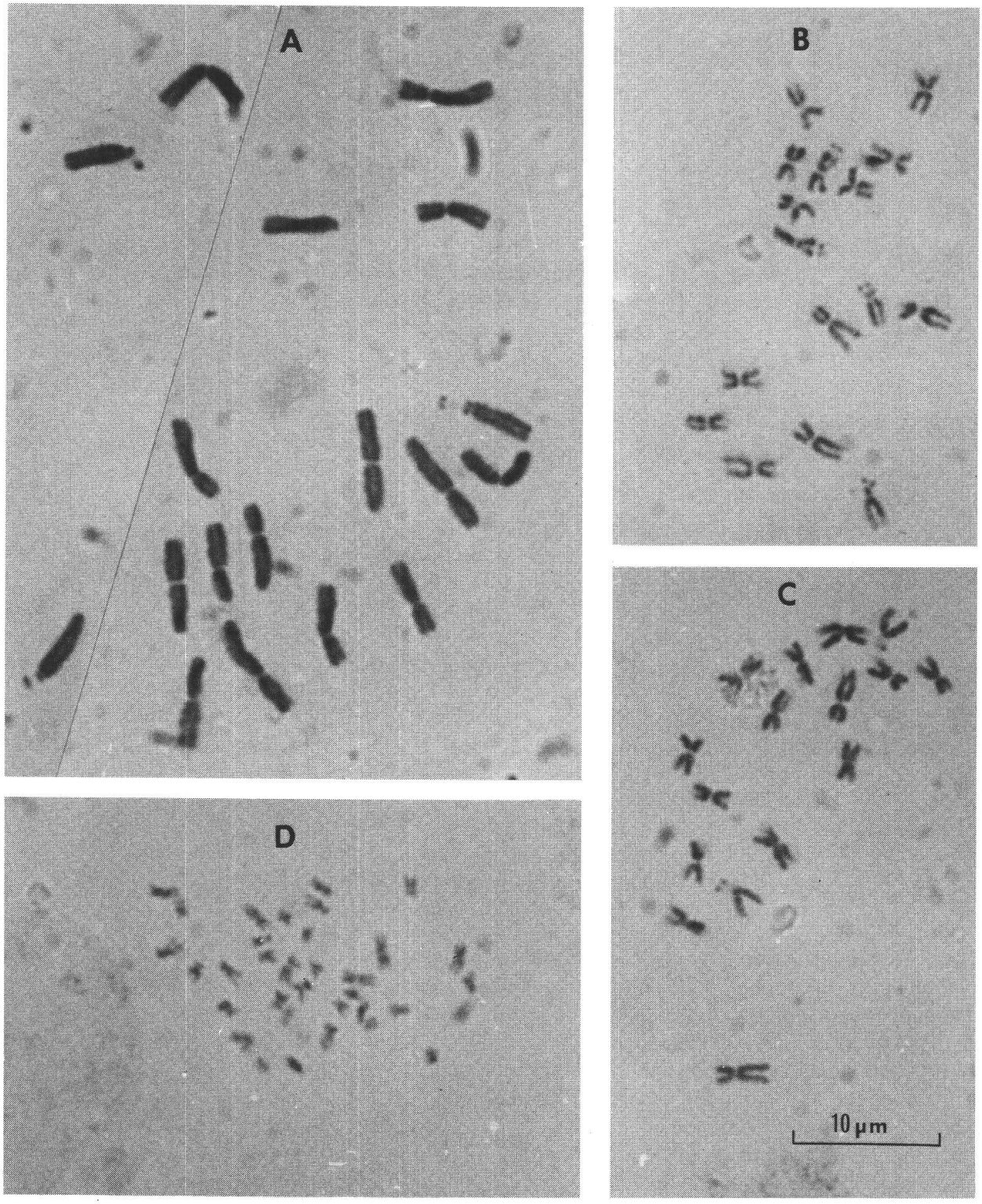

Fig. 1. Microphotographs of mitotic metaphase plates. A: *Anthemis glaberrima,* B: *Hyoseris radiata,* C: *H. scabra,* D: *Cynara cornigera.*

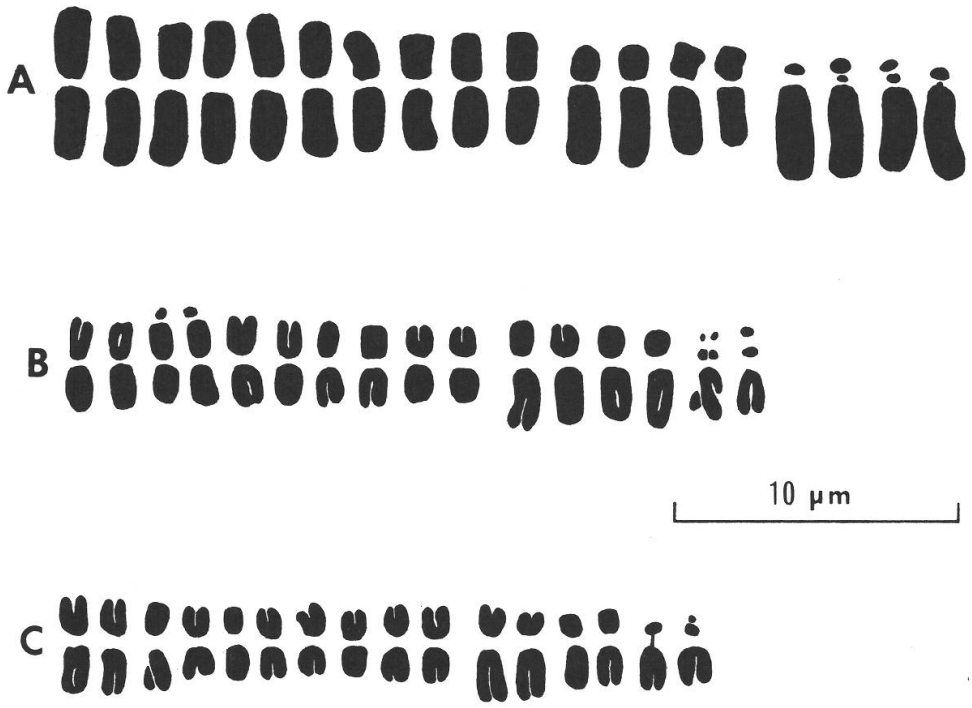

Fig. 2. Karyograms. A: *Anthemis glaberrima,* B: *Hyoseris radiata,* C: *H. scabra.*

chromosome number should be considered as very hazardous. This is because the size and the morphology of the chromosomes does not permit a karyotype analysis and the taxonomic position of this taxon within the Campanulaceae remains unclear. Contradriopoulos (1966) considered *C. trichocalycina* (=*Asyneuma trichocalycinum*) as a tetraploid, x = 8. This basic chromosome number is very common among the representatives of the genus *Asyneuma* but seems to be very rare in the genus *Campanula.*

Anthemis glaberrima (Rech. fil.) W. Creuter (2n = 18)

This species is one of the most localized endemics of the Aegean flora. It is known only from the islet of Agria Gramvousa which lies opposite to the W. North coasts of the island of Crete. *A. graberrima* seems to be taxonomically isolated from the remaining taxa of the genus and the cytological study revealed the chromosome number 2n = 2x = 18.

The haploid chromosome complement consits of five more or less metacentric (arm-ratio r = 1–1.7), two submetacentric (r = 1.9–2.5) and two telocentric (r > 7) chromosomes. All the telocentric chromosomes have nucleolar organizers (SAT-chromosomes) in the short arm (Fig. 1A and 2A). The total length of the haploid complement of *A. glaberrima* is appr. 35 µm and the length of the individual chromosomes ranges between 3–5 µm.

Cynara cornigera Lindley (2n = 34)

This taxon was formely known as *C. sibthorpiana* Boiss. & Heldr. and under this name Runemark et al. (1960) mentioned it from several localities in the S. Aegean area.

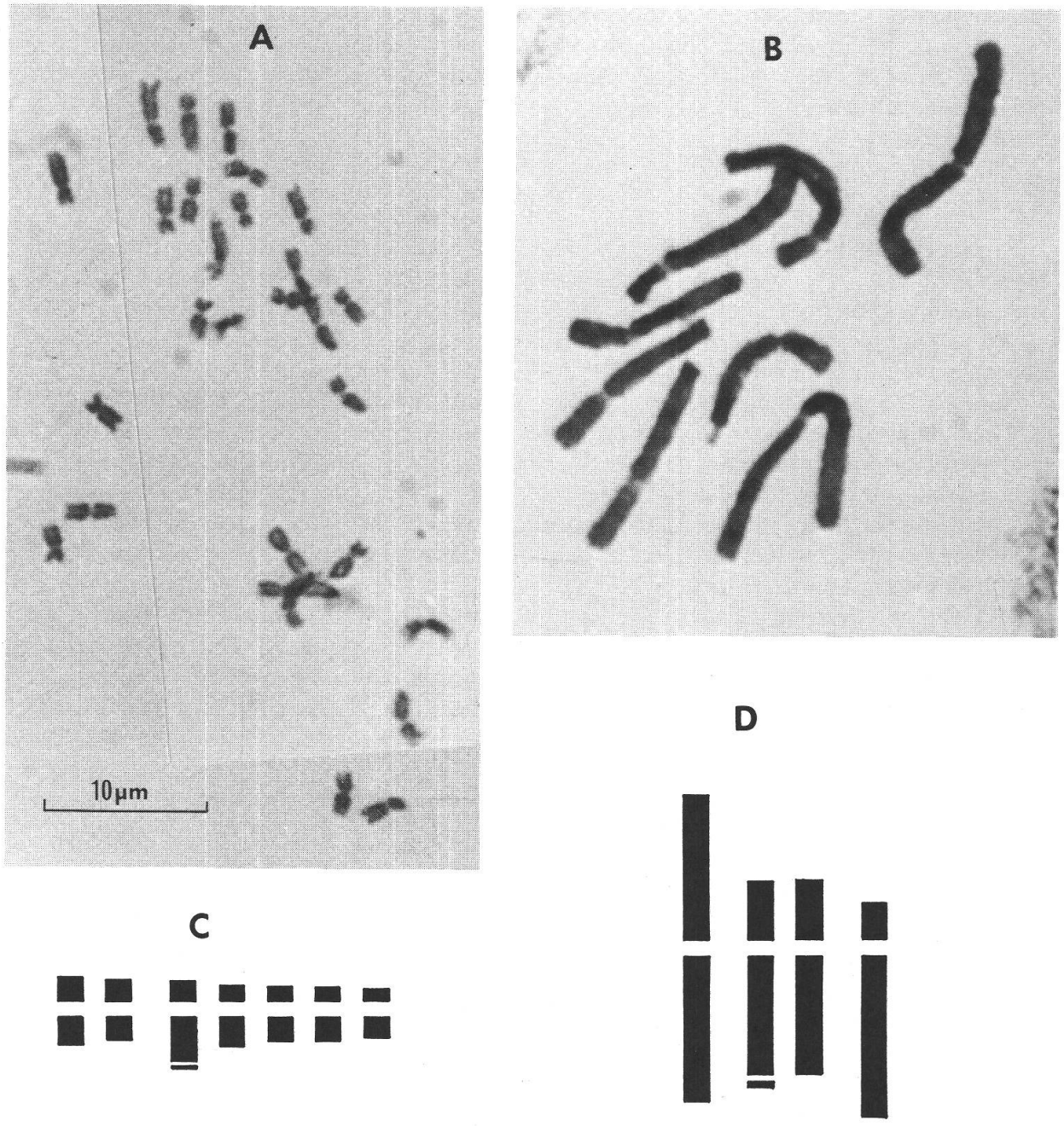

Fig. 3. A and B: Microphotographs of mitotic metaphase plates from *Asphodeline liburnica* and *Bellevalia brevipeticellata* respectively. C and D: Idiograms of the haploid complements of *A. liburnica* and *B. brevipedicellata* respectively.

Two populations have been studied and in both a chromosome number of 2n = 34 was found. This is obviously a diploid chromosome number (x = n = 17) and is common in many species of the genera *Cynara, Circium, Onopordum* etc. However, the origin of such a high basic chromosome number remains problematic and many Botanists believe that it is a secondary basic chromosome number derived by a mechanism in which allopolyploidization and aneuploid reduction processes are involved (Arano 1965, Valdes 1984).

In spite of the small size of the chromosomes the karyotype of *C. cornigera* looks very asymmetrical in both, chromosome size and chromosome morphology. Some chromosomes are very small, appr. 1 μm but other are more than twice that size. Also chromosomes with median, submedian or subterminal to terminal centromere have been observed (Fig. 1 D).

Hyoseris radiata L. (2n = 16)

This taxon although widespread in the Mediterranean basin, is not very common in Greece. Halacsy (1902) and Rechinger (1943) mentioned it from Crete and Naxos and the former author from a few localities in South-Western Peloponnisos.

H. radiata is a typical element of the littoral flora and in the Aegean region always occurs in the sandy shores of the islands and islets.

The material investigated here belongs to the taxon *H. radiata* ssp. *graeca* Halacsy, and in all the populations studied a chromosome number of 2n = 2x = 16 was found. The same chromosome number has also been given by Martinoli (1953) in material from Sardinia.

With regard to the chromosome morphology, the chromosomes of *H. radiata* are rather small, the total length of the haploid complement is appr. 20 μm and the size of the chromosomes varies from 2 to 2.7 μm.

Five of the chromosomes of the haploid complement are metacentric (r = 1–1.4), two submetacentric (r = ca 2), and one subtelocentric (r = ca 5). The subtelocentric chromosomes and those of a metacentric pair are satellited (Fig. 2 B). It must be pointed out that in the karyotypes of four Sardinian species of *Hyoseris* studied by Martinoli (1953) SAT-chromosomes of any type have not been mentioned.

Hyoseris scabra L. (2n = 16)

This is a taxon closely related to the former but more evenly distributed in the Mediterranean basin and more common in Greece, mainly as member of the Phrygana communities.

One Cretan population has been cytologically investigated and a chromosome number of 2n = 16 was also found.

From a morphological point of view the karyotypes of *H. scabra* and *H. radiata* look very similar. However, two karyotype differences should be mentioned. In the karyotype of *H. scabra* metacentric SAT-chromosomes have not been observed and in the same species the total length of the haploid complement seems to be a somewhat smaller than that of *H. radiata.*

Asphodeline liburnica (L) Reichenb. (2n = 28)

A. liburnica is an Eastern mediterranean element and its distribution extends from South Italy to Turkey.

In Greece *A. liburnica* has been found mainly in the high mountains of Continental Greece and in the gorges of Crete. Runemark et al. (1960) also mentioned it from the island Naxos.

One Cretan population has been studied and a chromosome number of 2n = 28 was found. The same chromosome number has been found in material collected from Olympos (Strid & Franzen 1981). Also Loon & Kieft (1980) and Moore (1982) mentioned the same chromosome number in material collected from Jugoslavia and Bulgaria, respectively. However, Borhidi (1968) found the chromosome number 2n = 14 in

material from Bulgaria and, therefore, the chromosome number 2n = 28 should be considered as tetraploid (2n = 4x = 28). The study of the chromosome morphology seems to support this aspect since, in the metaphase plates 8 metacentric and 20 submetacentric chromosome are observed and the existence of a haploid complement of the formula x = 7 = 2m + 5sm is suggested (Fig. 3 C). Four chromosomes of the submetacentric chromosome group are more easily distinguishable in the metaphase plates. These are evidently larger than the remaining and usually have a small satellite attached to the telomere of the long arm (Fig. 2 A). As these SAT-chromosomes are almost identical in morphology (size appr. 3.7 μm and arms ratio appr. 2.2 μm) probably consist a group of homologous chromosomes.

The remaining chromosomes are even smaller (1.9–2.8 μm) and size differences within the metacentric and submetacentric chromosome groups, are so small that the individual chromosomes are not easily distinguishable.

Asphodeline lutea (Scop.) Reichenb. (2n = 28)

The geographical distribution of *A. lutea* is similar to that of *A. liburnica* but the former seems to be more common in the area of Greece.

One population from Crete has been cytologically investigated and the karyotype revealed looks very similar to that of *A. liburnica* in both chromosome number and morphology. The chromosome number, 2n = 28, found in the Cretan material was also found in continental Greece (Strid & Franzen 1981) and Bulgaria (Borhidi 1968). The chromosome numbers 2n = 14, and 2n = 56 have also been reported for the species but the later probably was found in some ornamental variety (Fedorov 1969). Therefore, as in the case of *A. liburnica,* the population of *A. lutea* studied, should be considered as tetraploid.

Bellevalia brevipedicellata Turril (2n = 8)

This species is one of the most localized endemics of the Cretan flora known only from the SW part of the island.

This species has not been cytologically investigated before and the chromosome number, 2n = 8, found is a new record. The basic chromosome number x = 4, however, and the chromosome number 2n = 8 as well, seems to be common in the genus *Bellevalia* (Bothmer & Wendelbo 1981, Moore 1982).

The haploid complement consists of one metacentric (r = ca 1) two submetacentric (r = 1.8–2) and one subtelocentric (r = ca 4) chromosomes. In the metaphase plates one of the submetacentric chromosomes show a nucleolar organizer in the telomere region of the long arm (Fig. 3 B) but two SAT-chromosomes per metaphase plates have never been observed. Such an unstability concerning the appearance of the nucleolar organizers has already been mentioned by Bothmer & Wendelbo (1981) in karyotypes of *Bellevalia.* The chromosomes of *B. brevipedicellata* are very large, the total length of the haploid complement is appr. 50 μm and the metacentric chromosome is evidently larger than the others which do not differ substantially in size (Fig. 3).

Discussion

The taxa studied could be divided into two groups by means of their distribution range.

The first group includes the local endemics *Anthemis graberrima* and *Bellevalia brevipedicellata* while the second includes the remaining 6 taxa which show a wide, but very often scattered, distribution in the Mediterranean area. *Cynara cornigera* is included in the second group of species mainly due to its presence in three different phytogeographical subdivisions of the Aegean area (Crete, Cyclades, Eastern Aegean Islands) and also occur in Cyprus (Davis 1975).

The cytological results obtained from the investigation of the species of the first group are in agreement with earlier cytotaxonomical studies of the Cretan flora (Phitos & Kamari 1974, De Montmollin 1982 & 1984, and Tzanoudakis 1986a & b) which show that most of the Cretan endemics have diploid karyotypes.

The results of the study of the six remaining species belonging to the second group seems also to be very interesting from a cytotaxonomical and phytogeographical point of view. Some of them are obviously diploid viz *Hyoseris scabra* and *H. radiata* some others obviously polyploid viz *Asphodeline lutea* and *A. liburnica.* The chromosome number of the two remaining i.e. of *Campanula trichocalycina* and *Cynara cornigera,* could be of a diploid or a polyploid origin. However, they have an important cytogeographical character in common. Within the Mediterranean area populations of the same taxon occurring in different phytogeographical areas, and isolated geographically for million of years (see Greuter 1979), show a remarkable karyotype stability. The karyotype stability supports the view that most of these species are remnants of a very old flora distributed in the whole Mediterranean area during the Messiniano period and that many of them remained "unevolved" since the fragmentation of the Mediterranean land mass of the Messiniano and of the Aegean continent (Greuter 1972 & 1979).

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