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A new subspecies of *Biarum tenuifolium* (*Araceae*) from Crete

Abstract

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Biarum tenuifolium (L.) Schott subsp. *idomenaeum* Boyce & Athanasiou is described as new. The morphology, ecology and cytology of the new subspecies are discussed. A distribution map of the new taxon is given and a key to the infraspecific taxa of *B. tenuifolium* in the E Mediterranean is provided.

Introduction

Working on different aspects of the genus *Biarum* Schott (Boyce in prep., Athanasiou in prep.), both authors soon realised that the majority of material from Crete identified as *B. tenuifolium* (L.) Schott var. *zeleborii* (Schott) Engler in fact represented an undescribed taxon. This conclusion was reached on the basis of the distinct vegetative morphology of the collections, especially in the slender, very strongly undulate leaves. This Cretan taxon is ranked at the level of subspecies within *Biarum tenuifolium* because of the distinctive leaves, the less distinct but nevertheless important floral differences, geographical separation and karyological data.

The genus *Biarum* consists of 20 species of dwarf geophytes occuring from Portugal to Iran and from Yugoslavia to Jordan. The majority of species present little difficulty in identification. There are, however, two species aggregates that pose considerable taxonomic problems. One of these, the *B. bovei* complex, is discussed fully in the forthcoming revision of the genus (Boyce in prep.). The other still more complex aggregate centres around *Biarum tenuifolium* (L.) Schott. There are two discrete centres of diversity for the *B. tenuifolium* complex, one in the Afro-Iberian Mediterranean and the other in the E Mediterranean, primarily in the Balkans. The Afro-Iberian taxa will be discussed in the full revision (Boyce in prep.).

In the Balkans, *Biarum tenuifolium* consists of three subspecies, including the one described in the present paper. Two of these are vegetatively uniform — subsp. *abbreviatum* (Schott) Boyce (combination to be published elsewhere) and subsp. *idomenaeum* — while the third (subsp. *tenuifolium*) is divisible into two varieties (var. *tenuifolium* and var. *zeleborii*).

Morphology

Biarum tenuifolium sensu lato is readily distinguishable from all other *Biarum* species

in the E Mediterranean by the presence of both pistillodes and staminodes. All other species lack staminodes. The shape, size and arrangement of these sterile flowers, together with the shape and size of the leaves is the basis for the proposed classification. *B. tenuifolium* var. *tenuifolium* is distinguished by producing two types of leaves: those of the first flush are oblanceolate to elongate-spathulate with slightly wavy margins, and in general are more than 20 cm long; those of the second flush tend to be linear-lanceolate to (rarely) linear-spathulate, with flat margins. Var. *zeleborii* is readily distinguishable from both subsp. *abbreviatum* and subsp. *idomenaeum* by its far more robust habit, longer spathe and more robust, hooked pistillodes. In the foliage, var. *zeleborii* is similar to the above-mentioned taxa in that it produces only one type of leaf. However, the leaves are far longer than those typical of subsp. *abbreviatum* and subsp. *idomenaeum*, and differ considerably in shape. The two varieties differ from each other, i.a., by the arrangement of the sterile flowers and the degree of thickening of the spadix-appendix.

B. tenuifolium subsp. *abbreviatum* and subsp. *idomenaeum* produce leaves of a single type. In subsp. *abbreviatum* they are oblanceolate, upright, at most gently undulate, and usually less than 15 cm long, while in subsp. *idomenaeum* they are linear, usually appressed to the ground and with strongly undulate margins. Apart from vegetative distinctions, subsp. *abbreviatum* and subsp. *idomenaeum* have rather similar inflorescences, both producing spathe is considerably smaller than those of the typical subspecies. They are readily distinguished by the scattered, peg-like staminodes of subsp. *abbreviatum* as contrasted to the almost filamentous, evenly distributed staminodes of subsp. *idomenaeum*. The infraspecific taxa of *Biarum tenuifolium*, in the E Mediterranean, are keyed out below.

Taxonomy

Key to the *Biarum tenuifolium* complex in the E Mediterranean

1. Leaf lamina 15-49 cm x 11-21 mm; spadix appendix 10-41 cm x 2-9 mm ..... subsp. *tenuifolium* 2
— Leaf lamina 2.5-10 cm x 2-9 (-14) mm; spadix appendix 3-12 cm x 1.5-4 mm 3
2. Leaf lamina 15-25 cm x 11-15 mm; spadix appendix 10-41 cm x 2-3 mm; leaves, in mature individuals, oblong-lanceolate early in the season, linear-lanceolate later in the season ..... var. *tenuifolium*
— Leaf lamina 20-40 cm x 16-21 mm; spadix appendix 10-12 cm x 4-9 mm; leaves, in mature individuals, always oblong-lanceolate ..... var. *zeleborii*
3. Staminodes and pistillodes peg-like; leaves spathulate, erect, margins gently undulate ..... subsp. *abbreviatum*
— Staminodes and pistillodes almost filamentous; leaves linear-oblong, margins strongly undulate, usually appressed to the ground ..... subsp. *idomenaeum*

Biarum tenuifolium (L.) Schott subsp. ***idomenaeum*** Boyce & Athanasiou **subsp. nova.** — (Figs. 1, 2).

Typus: Kriti, Prov. Rethymnou, Mt. Psiloritis, rocky places with macchia and phrygana, above the village of Vizari, 650-750 m, 23 November 1988, *Athanasiou & Anagnostopoulos 566*, (holotypus UPA; isotypus K).

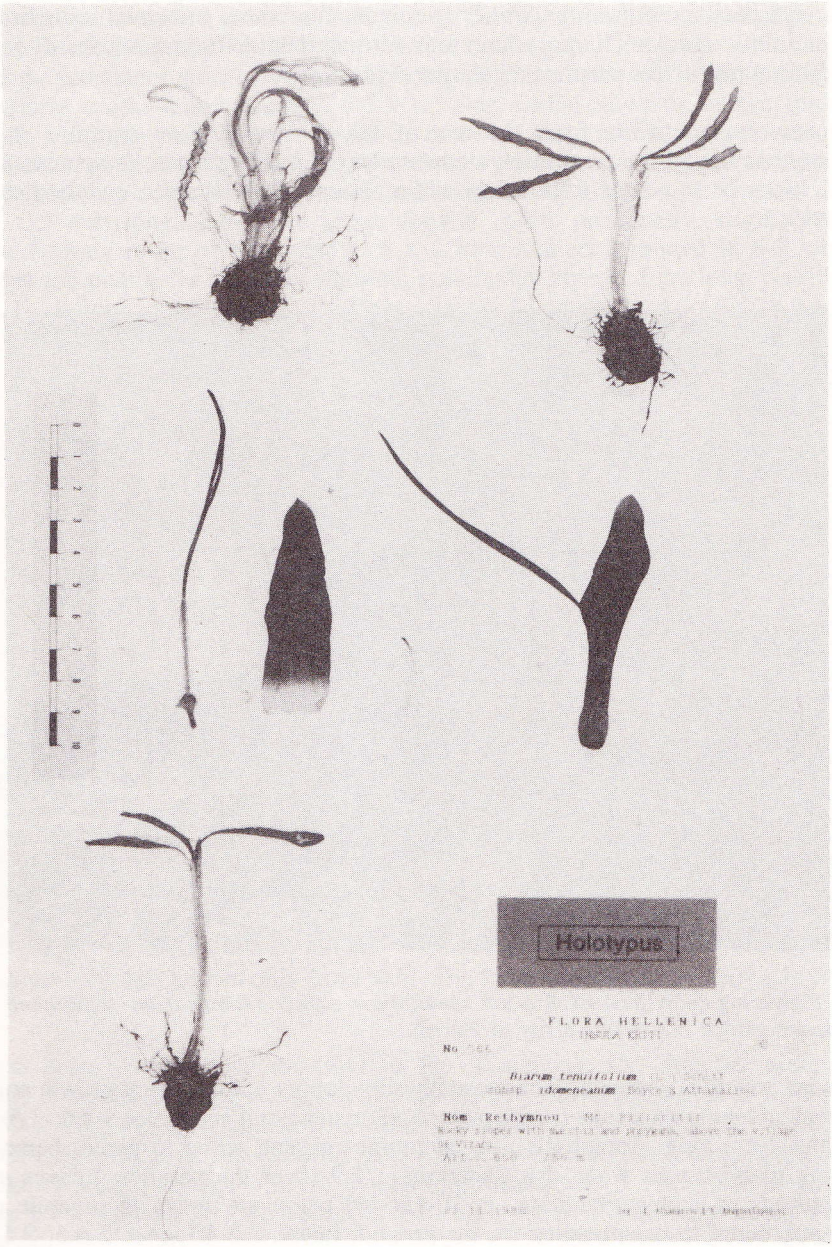


Fig. 1. *Biarum tenuifolium* (L.) Schott subsp. *idomenaeum* Boyce & Athanasiou (*Athanasiou & Anagnostopoulos 566*, UPA).

Ab aliis subspecibus *Biarum tenuifolii* regionis mediterraneae orientalis foliis linearibus valde undulatis rosulam humo adpressam formantibus differt; a subsp. *abbreviato* staminodiis et pistillodiis tenuibus regulariter digestis differt.

The new taxon differs from the rest of the *B. tenuifolium* complex in the E Mediterranean by the linear, strongly undulate leaves forming a rosette appressed to the ground. It can be separated from subsp. *abbreviatum* by the slender, evenly distributed staminodes.

Fig. 2. Flowering individual of *Biarum tenuifolium* subsp. *idomenaeum* (cultivated in the experimental garden of the University of Patras).

A dwarf, tuberous perennial. Tuber usually sub-globose with a central growth point and peripheral adventitious shoots on the upper and/or sublateral surface, 2.5-3.0(-3.5) cm in diam. and 2 cm long. Cataphylls 3-4, sometimes absent, white to green, herbaceous, becoming membranous when dry, sheathing 1/3-9/10 of the petioles. Leaves annual, hysteranthous to subhysteranthous, c. 10-15(-16) per plant, fewer in juvenile plants; lamina appressed to or spreading on the ground, linear, 2.5-10 cm x 2-6.5(-9.5) mm, decurrent, the margins strongly ondulate, the apex obtuse to sub-acute, the mid-vein pronounced, the venation reticulate, with 3-4 primary lateral veins per side; petioles mostly subterranean, usually equalling the lamina, (2-)2.5-6(-8) cm long, cuneate distally, abruptly widening underground and sheathing one another, white with 9-11 red to purple veins. Inflorescence enclosed by 1-3 membranous cataphylls that are oblong-lanceolate, abruptly attenuate above, up to 2.5 x 1 cm, white proximally and purple distally, or entirely purple. Peduncle subterranean, 1.5-5(-6) cm x 2-3.5 mm in diam., whitish; spathe

6-8 cm long, spathe tube 3 cm long, 7-10 mm in diam., somewhat inflated proximally, margins ± fused, externally with its proximal, 1 cm long portion white with dark red veins, for the remainder greenish purple to black-purple, internally white proximally, deep purple distally; spathe limb lanceolate, 3-5 x 1.5-2 cm curled outwards, obtuse, minutely mucronate, uniformly black-purple; spadix up to 13 cm long; spadix appendix elongate-cylindric, shortly stipitate, 8-9 cm x 2-3 mm, distally acute, proximally cuneate, greenish yellow, tinged purple; pistillate flowers in a hemispherical cluster c. 2.5 mm in diam., ovary c. 0.5 mm long, pale olive green distally, white proximally, stigma sessile; staminate flowers in an oblong zone c. 6 x 2 mm, anthers arranged in 6-7 whorls; staminodes and pistillodes regularly whorled, staminodial zone c. 2 cm long, pistilllodial zone c. 1 cm long, sterile flowers patent, almost filamentous, sometimes hooked, yellowish white.

Ecology. — *Biarum tenuifolium* subsp. *idomenaeum* grows in rocky, calcareous soil, in rather dry habitats (e.g. Cape Sideros). It is usually found in low, grazed macchia and dwarf phrygana; these types of vegetation mainly consist of: *Pistacia lentiscus* L., *Coridothymus capitatus* (L.) Reichenb. fil., *Euphorbia acanthothamnos* Boiss., *Erica manipuliflora* Salisb., *Sarcopoterium spinosum* (L.) Spach, *Hypericum empetrifolium* Willd., *Phillyrea latifolia* L. and *Phlomis cretica* C. Presl. In many instances, subsp. *idomenaeum* shares its habitat with *Biarum davisii* Turill subsp. *davisii*.

Growth cycle. — *Biarum tenuifolium* subsp. *idomenaeum* starts sprouting in late August when the inflorescence first appears. The flowering period usually ends by October, but occasionally anthesis may be prolonged into November. The inflorescence usually lasts for two days, with the strongest odour production occuring for the first few hours after opening, which is the period when the stigma is receptive. Immediately after flowering the first leaves appear. Unlike many other *Biarum* taxa it shows no distinction in shape between the first leaves and those produced later. The leaves remain green throughout the winter and spring, beginning to wither during the first half of May.

Distribution.—To date known only from Kriti. The known localities are shown in Fig. 3.

Specimens seen. — Kriti: Nomos Irakliou, Ep. Temenous: Mt. Youktas, around the chapel and in the surrounding phrygana, alt. 700 m, 5.10.1987, *Athanasiou & Athanasiou s.n.* (UPA); 20.3.1989, *Athanasiou & Anagnostopoulos 585* (UPA, K). — Nomos Rethymnou, Ep. Amariou: Mt. Psiloritis, rocky slopes with macchia and phrygana, above the village of Vizari, alt. 650-750 m, 13.11.1988, *Athanasiou & Anagnostopoulos 566* (holotype UPA; isotype K). Mt. Psiloritis (Mt. Ida), above Vizari, stony mountainside facing west, open stony slopes among *Quercus*, 29.11.1939, *Davis 1056* (E, K). — Nomos Lasithiou, Ep. Sitias: Toplou Monastery, stony ground with phrygana, alt. 200 m, 25.11.1988, *Athanasiou & Anagnostopoulos 557* (UPA, K). Mt. Mouros (Cape Sideros), dwarf phrygana, on rocky and sandy ground, alt. 200 m, 22.3.1989, *Athanasiou & Anagnostopoulos 597* (UPA, K). Zakros to Xerokampos, 2 km before Xerokampos, above a deep gorge, in terra rossa pockets in hard limestone cliffs, 100 m, 9.11.1980, *Brickell & Mathew 10212* (K). Above Zakros, 6.12.1939, *Davis 1075* (E, K). Topiou (Toplou), 8.12.1939, *Davis 1087* (E, K). "Near Sitia", *Kåe s.n.* (C).

Cytology

a. Materials and methods

The cytological study is based on material collected from the wild and cultivated in the experimental garden of the Botanical Institute, University of Patras. For cytologically investigated populations, localities, collectors and chromosome numbers are listed in Table 1. Voucher specimens are deposited in the Botanical Museum of Patras University (UPA) and in Kew (K).

Table 1. Origin of cytologically investigated material.

Pop.no.	Localities, *collectors*	2*n*
1	Nomos Irakliou, Ep. Temenous: Mt. Youktas, around the chapel and in the surrounding phrygana, alt. c. 700 m, *Athanasiou & Anagnostopoulos 585*	26
2	Nomos Rethymnou, Ep. Amariou: Mt. Psiloritis, rocky slopes with macchia and phrygana, above the village of Vizari, alt. 650-750 m, *Athanasiou & Anagnostopoulos 566*	26
3	Nomos Lasithiou, Ep. Sitias: Toplou Monastery, stony ground with phrygana, alt. 200 m, *Athanasiou & Anagnostopoulos 557*	26
4	Nomos Lasithiou, Ep. Sitias: Mt. Mouros (Cape Sideros), dwarf phrygana, on rocky and sandy ground, alt. 200 m, *Athanasiou & Anagnostopoulos 597*	26

For the study of the karyotype, a modified Östergren & Heneen (1962) technique has been applied. Root tips obtained from potted tubers were pretreated for 4 hours in a 0,002M 8-hydroxyquinoline solution, fixed in a 3 : 1 absolute ethyl alcohol/acetic acid solution, hydrolysed for 12 min. in 1N HCl at 60°C and stained using the routine Feulgen method. The identification of the centromeric position and the nomenclature of the chromosomes is according to Levan & al. (1965). All measurements have been performed on photos at high magnification from microscope film negatives. However, no detailed list of chromosomal sizes is presented here; only average values are stated.

b. Results

Biarum tenuifolium (L.) Schott sensu lato is known to possess three chromosome numbers, viz., $2n = 16, 20, 26$ (Bedalov 1969, Del Caldo 1971, Marchant 1972, Monti & Garbari 1974). Among these authors, Marchant (1972) was the only one to report chromosome counts from Greek material, identified as *B. tenuifolium* (L.) Schott var. *abbreviatum* (Schott) Engl. Marchant also published a detailed sketch of the karyotype.

The karyological study of *B. tenuifolium* subsp. *idomenaeum* showed that it is diploid with $2n = 26$. Its basic number is considered to be $x = 13$, which might be the result of

aneuploidy, as suggested by Petersen (1989).

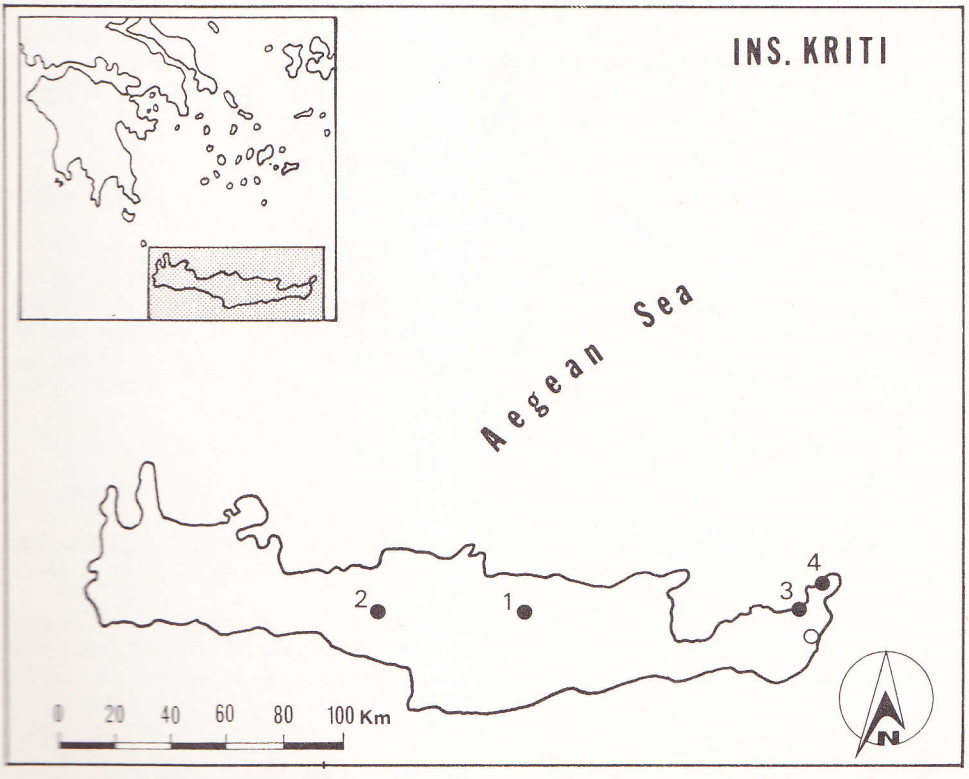
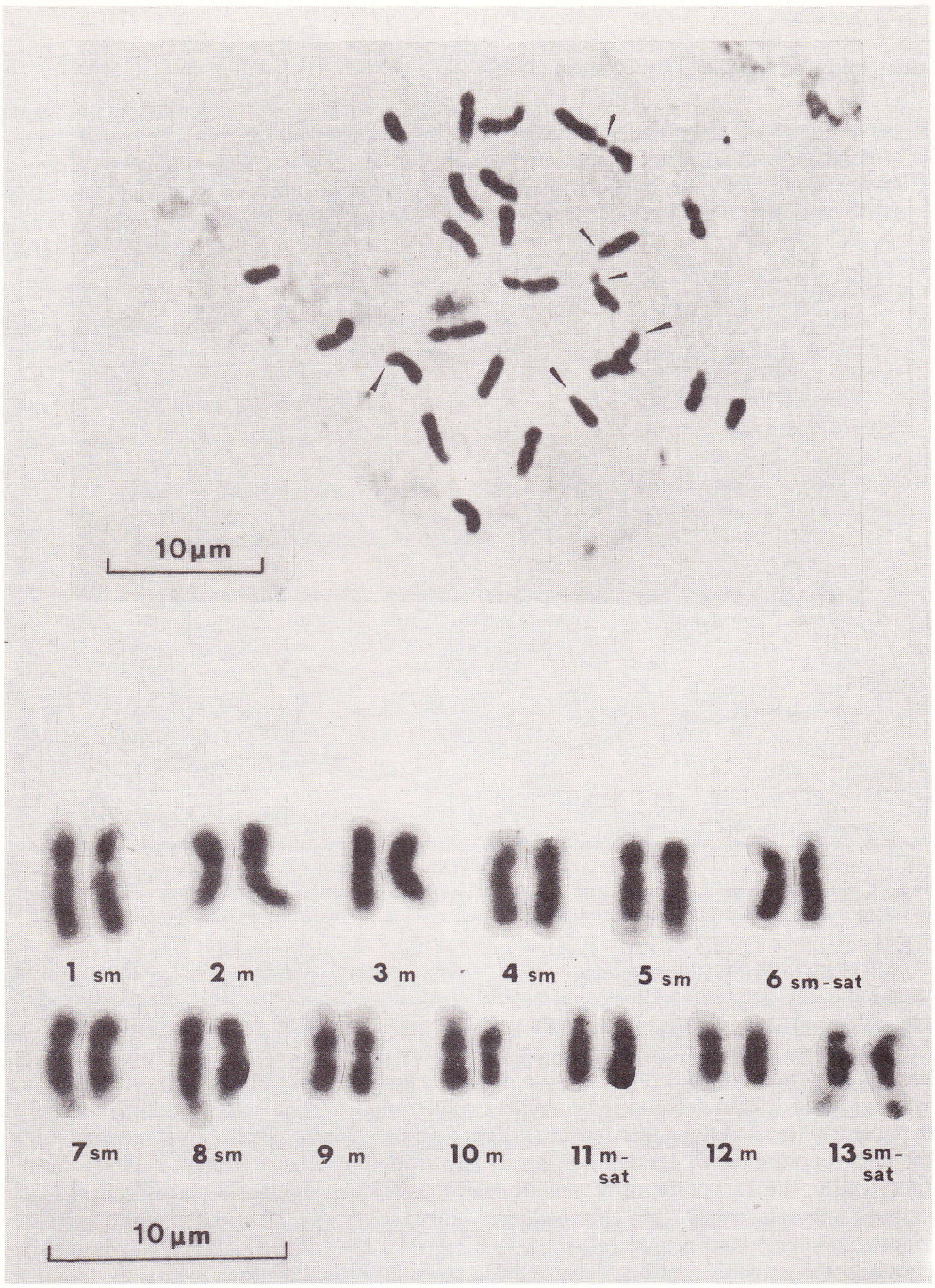


Fig. 3. Geographical distribution of *Biarum tenuifolium* subsp. *idomenaeum*. Filled circles indicate cytologically investigated material. Open circles indicate herbarium material.

Although both *Biarum tenuifolium* subsp. *abbreviatum* (Marchant 1972, Athanasiou in prep.) and var. *zeleborii* (Athanasiou unpublished) have $2n = 26$ as well, their karyotypes are different, when compared with one another and with *B. tenuifolium* subsp. *idomenaeum*. These differences will be thoroughly discussed elsewhere (Athanasiou, in prep.). The chromosomes of subsp. *idomenaeum* are generally of small to medium size, varying from 2.5 to 4.5 μm. The r-index values range from 1.16 to 2.78; thus only metacentric (m) and submetacentric (sm) chromosomes exist. This is in agreement with the data reported for *B. tenuifolium* sensu lato from Yugoslavia (Bedalov 1969). More specifically, the karyotype of *B. tenuifolium* subsp. *idomenaeum* is characterised by 7 pairs of submetacentric (sm) chromosomes, (no. 1, 4, 5, 6, 7, 8 and 13) and 6 pairs of metacentric (m) chromosomes, (no. 2, 3, 9, 10, 11 and 12) (Fig. 4). Moreover, chromosome pairs no. 6 and 11 have satellites on their shorter arms, while no. 13 has a satellite on its longer arm. On various metaphasic figures, long arm extremities of chromosome pairs no. 5, 7 and 8, as well as short arm extremities of no. 4, 9, 10 and 12, appear to be weakly stained in respect to the rest of the chromosome (Figs. 4-5). This could be the result of delay in spiralisation cycle, and therefore it is not observed in



Figs. 4-5. Mitotic metaphase plate of *Biarum tenuifolium* subsp. *idomenaeum* (Pop. 3), showing $2n = 26$ chromosomes. Arrow indicates sat-chromosomes; Karyogram of *Biarum tenuifolium* subsp. *idomenaeum* constructed using the same plate as in Fig. 4.

strongly contracted chromosomes, e.g. when colchicine is used for pretreatment; in such plates satellites are usually not at all evident. Giemsa staining might prove that these extremities are of heterochromatic origin and thus of systematic value.

A number of secondary constrictions are also present on long chromosome arms (Fig. 5). More data on the cytology of *B. tenuifolium* subsp. *idomenaeum* will be included in a detailed karyological study of the *Biarum* taxa occuring in Greece, which is under preparation by the second author.

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