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BIARUM TENUIFOLIUM (ARACEAE), A NEW RECORD FOR THE FLORA OF TUSCANY

Abstract - *Biarum tenuifolium* (Araceae), a new record for the flora of Tuscany. A new isolated site of *Biarum tenuifolium* (L.) Schott was discovered in southern Tuscany (Grosseto province), ca. 170 km to the north-west of the northernmost site known at present in Latium. The finding allows to add a new species (and genus) to the regional flora. Geographical, ecological, phenological and karyological details of the Tuscan population are provided in this study, together with a short discussion of its morphology in relation to some aspects concerning the still unclear infraspecific taxonomy of the plant in Italy. Based on current knowledge, the Tuscan population shows some of the diagnostic characters of *B. tenuifolium* subsp. *abbreviatum* (Schott) K.Richt., a mainly central-eastern Mediterranean taxon still not reported in the Italian floristic literature though indicated in a previous monographic work.

Key words - Araceae, *Biarum*, Grosseto province, infraspecific taxonomy, Tuscan flora

Riassunto - *Biarum tenuifolium* (Araceae), nuova entità per la flora della Toscana. Una nuova stazione di *Biarum tenuifolium* (L.) Schott è stata rinvenuta nella Toscana meridionale (provincia di Grosseto), a circa 170 km a nord-ovest dalla stazione più settentrionale nota ad oggi per questa specie, sita nel Lazio centrale. Il ritrovamento consente di aggiungere un nuova specie (e un nuovo genere) alla flora regionale. Si forniscono dati geografici, ecologici, fenologici e cariologici per la nuova popolazione, assieme ad alcune considerazioni sulla sua morfologia in rapporto all'ancora non chiara tassonomia infraspecifica di questa pianta in Italia. In base alle conoscenze attuali, la popolazione toscana presenta i caratteri diagnostici di *B. tenuifolium* subsp. *abbreviatum* (Schott) K.Richt., un'entità del Mediterraneo centro-orientale non riportata nella letteratura floristica italiana sebbene indicata in un precedente lavoro monografico.

Parole chiave - Araceae, *Biarum*, flora toscana, provincia di Grosseto, tassonomia infraspecifica

INTRODUCTION

According to Boyce (2006), the genus *Biarum* Schott includes 21 species of dwarf tuberous-stemmed herbs occurring in semi-arid and seasonally dry areas of southern Europe, North Africa and Near/Middle East. The center of diversity is the Middle East, where the majority of the species occur as endemics. All species have a strongly seasonal growth activity; the plants begin to grow in late summer or early autumn with the onset of the rainy season, and continue into late

spring, when they become dormant at the start of the heat and drought of the summer. The majority of species blossom after this dry period of rest, hence during September and/or October; however, flowering also occurs in the spring months or late winter. The typical aroid inflorescences appear close to the ground and produce an extremely intense and unpleasant odor of cattle dung which attracts many insect species, especially flies. The fruits appear at or below the ground level and are camouflaged as to resemble small stones, usually white. No dispersal modes are known for *Biarum*, and it has been supposed that no seed dispersal has evolved to ensure avoidance of inhospitable environments for the survival of the populations (Bown, 2000).

Most species are often found in rock crevices and gravelly soil composed largely of limestone, but growing localities from other rock types have also been observed (e.g. Montelucci, 1949). *Biarum tenuifolium* (L.) Schott (\equiv *Arum tenuifolium* L.) belongs to *A.* subg. *Biarum* and is widely distributed in the Mediterranean countries (Italy, Serbia, Bosnia-Herzegovina, FYRO Macedonia, Albania, Greece, Spain, Portugal, Morocco, Algeria; Prime & Webb, 1980; Boyce, 2006; see also http://euromed.luomus.fi/euromed_map.php?taxon=512130&size=medium), although Castroviejo *et al.* (2007) reports that this species is replaced in the Iberian peninsula by a closely related endemic taxon, *B. arundanum* Boiss. & Reut.

In Italy, this species is relatively common in Sicily and becomes progressively rare in the peninsular regions, mainly on the Tyrrhenian side. The northern distribution limit known so far reached Latium, in the province of Rome (see Fig. 1; Pignatti, 1982; Buccomino & Stanisci, 2000; Conti *et al.*, 2005; Mayer, 2015). During botanical researches in southern Tuscany a new site of *Biarum tenuifolium* was discovered by the present author. This finding allows to add a new species (and genus) to the Tuscan flora and represents a considerable northwards extension of its range in the Italian peninsula. Geographical, ecological, phenological and karyological details of this isolated population are

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Figure 1. Approximate Italian distribution of *Biarum tenuifolium* (L.) Schott (black dots) and locality of the new site in southern Tuscany (black star).

provided below, together with a short discussion of its morphology in relation to some aspects concerning the infraspecific taxonomy of this plant in Italy.

THE TUSCAN LOCALITY OF *BIARUM TENUIFOLIUM*

Tuscany, province of Grosseto, between the villages of Sticciano and Montepescali, Poggio Romano, fissures of the calcareous rocks ('calcare cavernoso') in the macchia with old olive trees along the border of Tenuta "La Pescaia", near the summit of the hill; 42°54.396'N – 11°06.629 E, ca. 100 m; esp. NW, 15 May 2016, *F. Selvi* 3660 (fruit and leaves!, Herb. Selvi, FI!); *ibidem*, 2 October 2016, *F. Selvi* 3685 (flower, FI!). The approximate locality is shown in Fig. 1.

Description of the area and habitat of the population

Poggio Romano is a small hill reaching 110 m a.s.l., rising up at the western limits of the plain area between the villages of Sticciano and Montepescali, near to the border between the municipalities of Grosseto and Roccastrada. In former times, this plain area was occupied by wetlands of the ancient *Lacus Prilius*. The

hill was already inhabited in Etruscan times, as shown by the presence of tombs (Mazzolai, 1981), and was used for centuries for the cultivation of olive trees and as pastureland for sheep and horses. Geologically, the hill is constituted by "calcare cavernoso", an evaporitic formation of the Tuscan stratigraphic series consisting of calcareous and dolomitic rocks dating back to the Rhaetic age (Motta, 1969). In the locality mentioned above, *Biarum tenuifolium* is found with less than one hundred individuals, scattered over a surface of about one hectare. The density of the population is very low, as well as the number of fertile individuals. The plant shows a strong habitat selectivity, growing exclusively in the small cavities and fissures of the "calcare cavernoso" rocks. These have a characteristically rough and irregular surface, with holes, cells and cavities resulting from the stronger erosion of the calcium carbonate component compared to the fraction also containing Magnesium (i.e. the dolomitic rock). The depressed-globose tuber of the plant develops in these small cavities, using water and nutrients found in the small pockets of clay-rich "terra rossa" that are formed inside. These cavities represent a highly protective micro-habitat against various external factors, especially wild and domestic herbivores. As already observed by Montelucci (1949) on populations near Tivoli (Rome), the plant clearly seeks protection from especially the grazing of sheep, which explains its complete absence in the open soil amongst other herbaceous species. A further protection is given by the dense evergreen shrubs that often surround and cover the calcareous rocks, such as *Pistacia lentiscus* L., *Phillyrea* sp.pl. and the resprouts of old olive trees. Consequently, *Biarum* plants often grow in at least partial shade, caused by this shrub cover. Tolerance to shading was already reported by Montelucci (1949), who observed plants growing in the understory of even chestnut forest.

PHENOLOGICAL NOTES

According to Boyce (2006), the inflorescences of *B. tenuifolium* appear in late summer to mid-autumn and occasionally in the spring. Concerning the Italian material, the occurrence of two flowering seasons is supported by the analysis of several Italian collections (FI!, see *specimina visa*). Although most of the examined flowering specimens were collected in autumn, spring-flowering collections from Sicily and Latium were also present, mixed with autumn-flowering specimens. Pirotta & Cortesi (1907) observed that the populations from Latium blossom in October and November as well as in May-June, and this is supported by the existence of spring flowering specimens from the area of Rome (incidentally, one of the type localities of the species mentioned by Linnaeus, 1753).

Parlatore (1852) reported that the Italian plants blossom two times in the same year, but sometimes only in spring or in the autumn. According to Fiori (1923), spring flowering would be typical of *B. tenuifolium* var. *cupanianum* (Guss. ex Paglia) Nicotra ex Fiori, endemic to Sicily, while autumn-flowering would occur in the typical subspecies found in the Italian peninsula. However, this is in contrast with Mayer (2015), who reports that flowering of *B. tenuifolium* subsp. *tenuifolium* in central Italy is in late spring or at the beginning of the summer. The numerous spring visits to the Tuscan locality allow to exclude that the plants flower in May or June. During these months, the few fertile plants produce hypogeous infructescences from the inflorescences appeared in the previous autumn. Based on its exclusively autumn-flowering behaviour, therefore, the Tuscan population should be referred to the typical variety of *B. tenuifolium*. Another phenological character of systematic interest is the time of emergence of the leaves, since typical *B. tenuifolium* s.str. is reported to have synanthous leaves (e.g. emerging from the soil contemporary to inflorescence, in autumn) while *B. tenuifolium* var. *cupanianum* is reported to have hysteranthous leaves (e.g. appearing after flowering). In the Tuscan population the leaves are mostly hysteranthous, appearing from the soil in October, after the inflorescence in the fertile individuals (Fig. 1B), and reaching full development during the spring (mid May). Afterwards, the leaves start to wither and generally disappear before the end June, at the onset of the dry season.

MORPHOLOGICAL AND TAXONOMIC NOTES

The peculiar morphology of *Biarum* and of *B. tenuifolium* in particular is described in detail in Floras and especially in monographic works, such as Bown (2000) and Boyce (2006). Over its broad range, the species shows a relatively wide variation that has led to the recognition of several infraspecific units. According to Boyce (2006), there are six subspecies separated on the basis of leaf shape and size, spathe size, spathe limb/spadix length ratio, degree of staminode development and geographic distribution. Boyce (2006) reports that two of them occur in Italy: *B. tenuifolium* subsp. *tenuifolium*, described from “Dalmatia, Romae, Monspelii” (Linnaeus, 1753) and *B. tenuifolium* subsp. *abbreviatum* (Schott) K.Richt., described from Greece (Schott, 1860). The latter is an eastern Mediterranean taxon, occurring in Sicily and in the southern peninsular regions as well, though it has never been mentioned in the Italian floristic literature (Conti et al., 2005). This taxon is characterized by the peg-like staminodes and the spatulate leaf lamina, with gently undulate margins; in addition, it has generally a smaller size and the

spadix appendix is not much longer than the spathe limb (c. 1/3); this has a typically greenish apex (bicoloured; Boyce, 2006). These features also correspond to those distinguishing *B. tenuifolium* var. *cupanianum*, which was hence included as a heterotypic synonym in *B. tenuifolium* subsp. *abbreviatum* by Boyce (2006). *Biarum cupanianum* Guss. ex Paglia was originally described from Sicily, and considered by some authors as an Italian endemic species (Paglia, 1909). Fiori (1923) treated it at varietal rank and considered it restricted to Sicily, adding also the production of hypogeous (rather than epigeous) infructescences as a further distinctive character. Parlatore (1852) highlighted the strong morphological variability of the Italian plants especially in the size of leaves, spadix and spathe, regardless of their geographic origin. A summary of the characters putatively distinguishing *B. tenuifolium* subsp. *abbreviatum* from *B. tenuifolium* subsp. *tenuifolium*, compared with those shown by the Tuscan population, is reported in Tab. 1. Based on this summary table, it is possible to observe that the latter shows features intermediate between the two subspecies. Although it approaches subsp. *tenuifolium* in its autumn-flowering phenology (see above), it shows key diagnostic characters of subsp. *abbreviatum* such as the peg-like staminodes (Fig. 2D), the smaller size of the plant and shorter leaves (Fig. 2A), the spathe limb with green apex (bicoloured) and the spadix appendix not so much longer than the spathe limb (c.1/3; Fig. 2B, E). The leaves appearing in autumn have clearly undulate margins (Fig. 2F). Using the key in Boyce (2006) this population should be therefore referred to subsp. *abbreviatum*. In addition, the Tuscan population also has hypogeous infructescences (Fig. 1C), which is reported by Paglia (1909) and Fiori (1923) as typical for var. *cupanianum*. The flowering plants produce a powerful odour of cattle dung, which attracts various insects and especially flies (Fig. 2E).

KARYOLOGICAL NOTES

By the analysis of meristematic tissue of root tips collected in October 2016 from two cultivated plants, it was found that the chromosome number is $2n = 26$ (Fig. 3). Although the karyotype formula could not be determined, it was possible to observe that the complement is made of medium-sized (c. 8 μm) chromosomes of meta- to submetacentric and subtelocentric type, of which at least one pair shows satellites on the short arm. A range of diploid chromosome numbers has been recorded for *B. tenuifolium*, i.e. $2n = 16, 20, 26$ (Petersen, 1989; Tab. 1). Del Caldo (1971) found $2n = 16$ in plants from the province of Rome referred to as *B. cupanianum*, and this was confirmed on plants from the same region by Monti & Garbari (1974).

Table 1. Characters of the Tuscan population compared with the main diagnostic characters between *B. tenuifolium* subsp. *tenuifolium* and *B. tenuifolium* subsp. *abbreviatum*, after Boyce (2006).

	Tuscan population	subsp. <i>tenuifolium</i>	subsp. <i>abbreviatum</i>
Leaf appearance*	hysteranthous	synanthous	hysteranthous
Leaf lamina, cm	6-8 × 0.85	15-25 × 1.1-1.5	10 × 1.4
Leaf shape (early season)	oblong-lanceolate	oblong-lanceolate	oblanceolate to spatulate
Leaf margins	smooth to gently undulate	smooth	smooth to gently undulate
Flowering season	autumn	autumn	spring
Spathe limb size, cm	c. 8 × 1.5	up to 20 × 5 cm	c. 9 × 1.5
Internal colour of the spathe limb	bicoloured: deep purple brown below with a greenish apical portion	dark purple-brown without green apical portion	bicoloured: deep purple brown below with a green apical portion
Spadix appendix length	slightly longer than spathe limb (c. 1/3), stout	much longer than spathe limb (3-4 times); slender	slightly longer than spathe limb (c. 1/3), stout
Staminodes	poorly developed, peg-like	well-developed, hooked	poorly developed, peg-like
Infructescence*	hypogeous	epigeous	hypogeous
2n	26	16, 20, 26	26
Italian distribution	Grosseto province	Sicily, southern and central peninsular regions to Latium	Sicily, southern and central peninsular regions

* Character given by Fiori (1923) for *B. tenuifolium* var. *cupanianum* Nic.

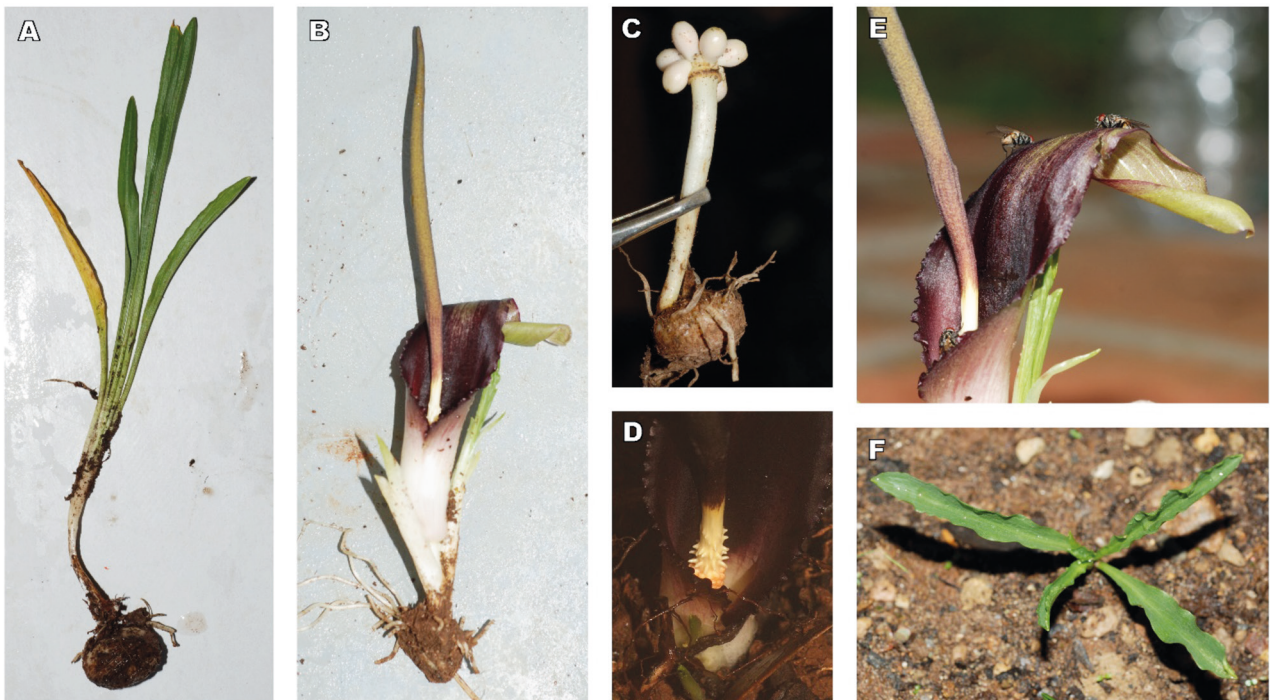


Figure 2. *Biarum tenuifolium* (L.) Schott from southern Tuscany: A) sterile plant in the spring season (May), showing depressed-globose tuber, stem and leaves; B) fully flowering plant in autumn (October), with leaves at a very early stage of development; the spathe limb is strongly enrolled at the apex so that the spadix appears much longer, though it is only c. 1/3 longer; C) fruiting plant with subterranean infructescence of white berries (May); D) lower part of the spadix with the peg-like staminodes; E); inflorescence visited by flies, which are attracted by its powerful odor of cattle dung; F) autumn leaves (early November), with gently undulate margins.



Figure 3. Metaphasic chromosome plate showing $2n = 26$. Scale bar = 5 μm .

These authors also found $2n = 20$ and 26 in plants from Sicily, and the latter number was also determined on material from the Balkan Peninsula (Lake Ohrid, Macedonia) belonging to *B. tenuifolium* subsp. *abbreviatum* (Marchant, 1972). Because of the variability of these numbers, Monti & Garbari (1974) concluded that *B. cupanianum* is not to be maintained at specific rank but sunken in synonymy of *B. tenuifolium*. Interestingly, the Tuscan population is karyologically more diverging from those of Latium than from those of more distant geographical regions (Sicily, Balkan peninsula).

CONCLUDING REMARKS

Biarum tenuifolium was previously never reported from Tuscany, although a sterile plant with only leaves was collected in spring 2009 by F. Cortes-Selva in a locality of the Parco Naturale della Maremma during a research program for the assessment and monitoring of plant biodiversity in this protected area (unpublished specimen SIENA 5473, see “*Specimina visa*”). This collection and the present finding show that this species belongs to the native regional flora. The main phytogeographical interest of the Tuscan sites is that they allow to extend some 170 km to the northwest the northern limit of the species range in Italy, resulting also among the northernmost sites for the whole species distribution. This distance is remarkable especially when considering that the dispersal capacity of the species by seed or other vegetative means is extremely

low or nearly non-existent (Bown, 2000). The causes for such geographical isolation are therefore difficult to assess, though it can be assumed that the population from Poggio Romano (and eventually that from Parco della Maremma) is the remnant of a formerly wider and more continuous range. Its extremely small size, restricted occurrence in the crevices of calcareous rocks and low fertility suggest that it has suffered restriction and decline possibly at a time when the grazing pressure was much stronger than today. At the regional level, the species is highly threatened and should be included in the list of protected species (Regional Law 56/2000), as in Latium (Buccomino & Stanisci, 2000). It should be observed, however, that the presence of the species in other localities of southern Tuscany and northern Latium is likely. The floristic knowledge of these territories is in fact still fragmentary and incomplete (Angiolini *et al.*, 2005; Anzalone *et al.*, 2005; Selvi, 2010), and potentially suitable habitats for *Biarum* such as calcareous garrigues, old olive orchards on rocky soil, open macchias etc. are widespread. Thus, further research can lead to the discovery of new sites of this interesting and uncommon plant. Additional findings may also help to make further phenological observations and to confirm the taxonomic identity of the Tuscan plants, which are here referred to *B. tenuifolium* subsp. *abbreviatum* Schott mainly based on the morphological characters of the inflorescence reported by Boyce (2006).

SPECIMINA VISA

Tuscany. Oliveti abbandonati Parco Maremma, località Vergheria, April 2009, *F. Cortes-Selva* (SIENA 5473, sterile; photo!). Latium. Tivoli, salita al Mt. Ripoli sopra i Cappuccini, 19 May 1905, (FI! fruit); ibidem, *Vaccari* 14 June 1905 (FI! flower); ibidem, *Vaccari*, 26 May 1903 (FI! flower); presso Albano, September 1889, *Martelli* (FI! sterile); locis herbosis vel caespitosis, in silvulis nec non in saxosis prope Romam, loco dicto *Settecamini*, October 1906 (sterile), et loco dicto *Lunghezza*, June et October 1906 (flor.), *Pirotta & Cortesi* (FI! Schedae ad Floram Italicam Exsiccata n° 512); Roma al Tuscolo, 12 December 1837, *Parlatore* (FI! sterile); intorno al Tevere..., June 1853, *Sanguinetti* (FI! flower); Tivoli, May 1856, *Sanguinetti* (FI! flower). Basilicata. Lucania, Potenza, in saxosis montis Fai, loco dicto Moggiona della Signora, solo siliceo, alt. c. 1000 m, 15 October 1922, *Gavioli* (FI! sterile); Pignola, in saxosis loco dicto Campo di Giorgio, October 1912, *Gavioli*, (FI! flower); in montosis apricis Lucaniae prope Castelgrande, April 1850, *Gasparrini* (FI! flower); Lucania, Potenza, in argillosis loco dicto Vallone del Malopasso, alt. c. 900 m, 12 October 1910, *Gavioli* (FI! flower). Campania. Mt. Picentini, spacca-

ture rupi V. Carria, 500 m, 11 February 1976, *Moraldo* (FI! sterile). Puglia. Ruvo di Puglia, October 1879, *Jatta* (FI! flower). Sicily. Messina, Capo Sant'Alessio, 7 June 1956, *Gramuglio* (FI! fruit); Segesta, 1853, *Sorrentino* (FI! flower); in collibus saxosis Avola, 1861, septembris-octobris *Bianca* (FI! flower); in pascuis montosis aridis supra Gibilrossa, 25 May 1856, *Huet du Pavillon* (FI! flower); Panormio, ubique, 1834, *Parlatore* (FI! flower); Palermo, falde di Monte Pellegrino vicino alla Renella, 1842, *Parlatore* (FI! flower); in herbosis Pal...Parco, May 1876, *Lojacono* (FI! flower and leaves); in collibus calcareis lapidosis, reg. inferiore et submontana, Palermo, 5 June 1903 *Ross* (FI! flower and leaves); Palermo, in collibus prope Boccadifalco, alt. 100-500 m, solo calcareo, 15 November 1913, *Vaccari* (FI! flower; Sched. Fl. It. Exs. 512bis); Cammarata, fra i sassi del monte, 3 November 1900, *Martelli* (FI! flower); Mondello prope Panormum, in apricis maritimis lapidosis, 3 June 1873, *Sommier* (FI! flower); Caccamo, luoghi sassosi aprici Malpasso, September 1890, *Guzzino Nicasio* (FI! flower); Trapani, in rupibus calcareis montis..., June 1924, *Ponzo* (Herb. Gavioli 6955, FI! flower); Palermo, falde del Mt. Pellegrino Favorita, 1895, *Sommier* (FI! flower).

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