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## *Arundo* (*Gramineae*) in the Mediterranean reconsidered

### Abstract

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Finding the recently described *Arundo hellenica* in Italy initiated a study on the identity of taxa related to *A. plinii*, in the field, in the literature and in several herbaria. According to the somewhat preliminary results, besides *A. donax* with nodding leaves, three species with upright leaves are proposed for recognition in the Mediterranean. Their distribution and ecology are still incompletely known. *A. plinii* in its original sense is shown to be a 1-2 m high riparian plant, so far confirmed to occur in N Italy, S France and, perhaps, NE Spain. *A. mediterranea* is described as a new species for the illegitimately named *A. mauritanica* of Desfontaines, which has hitherto been erroneously recorded as "*A. plinii*" and is a caespitose reed with 1-5 m long obliquely erect culms that branch already in the first year; it grows on alluvial clayey soils or high river terraces along temporary water courses of N Africa, Israel, Cyprus, Greece, Crete, Lebanon and possibly other East Mediterranean countries. *A. collina*, including the recently described *A. hellenica*, is the lowest (0.5-2 [-3] m) and most drought resistant *Arundo* of the Mediterranean and forms monotypic grasslands on clay in badlands, on hill slopes up to 300 m, on sides of newly constructed roads, etc. and is currently known to occur in S Italy, mainland Greece and Crete.

### Introduction

When the author found *Arundo hellenica* Danin & al. (2002), recently described from Greece, in Italy, growing between Fiumicino airport and Rome, and when he then attempted to understand the species concepts behind older names such as *A. plinii* Turra and *A. collina* Ten., he got aware of basic problems in the *Arundo* taxonomy. Excursions in Italy, southern France, on Crete and Cyprus followed to get an understanding of the habitats, population structure and morphological characters of the taxa involved. Search for historical collections was done in the herbaria of Montpellier (MPU), Aix en Provence (MHN-AIX), Kew (K), the Natural History Museum London (BM) and Genève (G and G-Boiss.). However, the author was not able to visit the Italian herbaria, nor, of course, all areas of importance for a more complete understanding of the distribution and ecology of the *Arundo* species here proposed for recognition in the Mediterranean. The reconsideration of *Arundo* in the present paper is thus deliberately preliminary. I wish to present my findings in the group of taxa related to *Arundo plinii*, to differentiate between the *Arundo* species and to bring back to use two old names that were unjustly sunk into the synonymy of

*A. plinii* long ago, in the hope that other botanists in the Mediterranean will critically take up and evaluate my observations and preliminary taxonomic conclusions in studying the *Arundo* populations in their countries.

### Morphological and ecological characterization of the taxa recognized

*Arundo plinii* Turra, Farsetia: 11. 1765  $\equiv$  *Arundo donax* subsp. *plinii* (Turra) Mateo & R. Figuerola Lamata, Fl. Analit. Prov. Valencia [IAM. Investig. 14]: 368. 1987. – Original herbarium at Museo Civico Vicenza destroyed, but some material, e.g., at LINN (fide Stafleu & Cowan 1986).

Turra, in the protologue, gives “in Hetruriae atque Bononiae fluviis” and [in his Fl. Ital. Prodr.: 63. 1780, in synonymy] “rheni bononiensis” as the occurrence of the species. “Hetruria” is Tuscany (Toscana), “Bononia” is Bologna, *Rhenus bononiensis* thus the Reno river of Bologna (Bertoloni 1833). Since extant original material is unknown, I went for the “locus classicus” and visited the Reno river in Bologna on 27.7.2004. There I found, indeed, apart from *Phragmites australis* and *Arundo donax*, populations of an *Arundo* with upright leaves, which may thus be safe to identify with *A. plinii* (Fig. 1A). The plant is basically riparian. Patches of dense vertical culms carrying distichous narrow upright (not nodding) leaves, each terminating in a single panicle, constitute 3-10 m long and 1-3 m wide rhizomatous patches. No last-year’s stems were present in the patches I observed. A few further patches occurred also on the gentle slope 1-4 m above the present river level. The above-ground parts, 1-2 m tall, are apparently renewed every year and the culms do not regularly branch. Extensive rhizomes growth makes the patches rather continuous along rivers. The leaves are easily distinguishable from those of the sympatric *Phragmites australis* by their green colour as compared with the bluish colour of the latter (due to a thin wax layer above the epidermis of *P. australis*). I could distinguish three belts of reeds on the opposite river bank, *Phragmites australis* growing closest to the river, *Arundo plinii* forming a belt above it, and *A. donax* forming the highest belt.

One population of *Arundo plinii* in southern France between Fréjus and St. Raphael, which was collected by many collectors since the 19th century, still exists near a bridge between the two villages. The second population of *A. plinii* recorded from France by dozens of specimens in the herbaria studied is that of the island of St Lucie, near Narbonne. I failed to discover the populations reported by Bolos & Vigo (2001) from a river draining towards Barcelona.

*Selected specimens seen.* – ITALY: Bologna, at the edge of Reno river, muddy ground, 27.7.2004, *Danin* (HUI); in fluvia Rheno Bononiense, 1840, *Tenore* (G). — FRANCE: Ile Sainte Lucie, près de Narbonne, molasse marine, 15 m, 27.9.1882, *F. Doumergue* (MHN-AIX); Ile Sainte Lucie près Narbonne, 8.9.1893, *Sevitién Jules & 1894* (MPU); Var, Puget sur Argens, Quartier Gabron Talus de la voie ferrée, 10.1909, *G. Bertrand* (MHN-AIX); bordes de champs, a Fréjus Toregus (4 m) et St Raphael, 24.8.1871, *B. Roux* (MHN-AIX); bord de la route de Cannes, près de Fréjus, 21.8.1899, *F. C. Bertrand* (MHN-AIX); between Fréjus and St Raphael at the edge of a drainage ditch, 25.7.2004, *Danin & J. Zaffran* (HUI).

### *Arundo mediterranea* Danin, **sp. nova**

Holotype: Israel, Nahal Sorek, 8 km east of Gedera, 18.9.2004, blooming culms from present year and previous year’s culms with branches, *Danin* (HUI); isotypes: B, BEO, BM, E, G, K, MPU, PAL).

$\equiv$  *Arundo mauritanica* Desf., Fl. Atlant. 1: 106. 1798, nom illeg. [non *Arundo mauritanica* Poir., Voy. Barb. 2: 104. 1789  $\equiv$  *Ampelodesmos mauritanicus* (Poir.) Durand & Schinz]. – Holotype: “Herbier de la FLORE ATLANTIQUE, donné au Muséum par M. Desfontaines” (P-00307101 [photo!]; probable isotypes: [Algeria], “ex herbario Desfontaines” (MPU!); “ex herbario Desfontaines” (K [a fragment of panicle donated by Mr Desfontaines in 1818]!); “*Arundo mauritanica* Fl. Atl. distincta ab *A. donax* L. Alger Desf.”, “*Arundo mauritanica* Desf.” [both in handwriting of A.-P. de Candolle, approved by Briquet, who added that this is an original of Desfontaines] (G!).

Latin diagnosis: See Desfontaines, Fl. Atlant. 1: 106.1798 under *Arundo mauritanica*.

The name *Arundo mauritanica* Poir. was given in 1789 to what is known today as *Ampelodesmos mauritanicus* (Poir.) Durand & Schinz. Evidently Desfontaines was not aware of the existence of Poiret's name when he published his *Arundo mauritanica* nine years later in the first volume of his Flora Atlantica, because later he attempted to get rid of Poiret's older homonym in the Adenda in the second volume (1799: 448), by treating it as a synonym of his own, though younger *Arundo festucoides* (= *Ampelodesmos mauritanicus*) ["*Arundo festucoides* 1. p. 108. Adde: *Arundo mauritanica*, calycibus trifloris; panicula elongata; foliis angustis, involuto-junceis. Poiret Itin. 2. p. 104."].

The first diagnostic character mentioned by Desfontaines (1798-99) when differentiating his new species collected in what is now Algeria from *A. plinii*, is the branching of the culms ("*Arundo culmo fruticoso*"). Later authors, who probably did not see the living plant, ignored this property, which is mostly not preserved in herbarium material, and considered only the similarity in the inflorescences. Of the dozens of herbarium specimens I have seen from Algeria, only one shows the zone of branching. Consequently, *A. mauritanica* Desf. was sunk by subsequent authors into the synonymy of *A. plinii*. After consulting a photo of the holotype, photographs from plants in Algeria (Somon 1987: 20) and collections made near Algiers, it became evident to me that *A. mediterranea* inhabits also Israel, Cyprus, mainland Greece, Crete and Lebanon but is regarded by authors of the floras of these countries and others, as *A. plinii*. A most recent record of the latter from Cyprus by Danin & Hadjikyriakou (2004) has also to be referred to *A. mediterranea*.

The branched culms of *Arundo mediterranea* (Fig. 1B, C) in fact distinguish it very well from *A. plinii*. Even before blooming, the well developed lateral buds start to elongate and emerge by breaking through the leaf sheath some 1.2-1.5 m below the base of the panicle. After anthesis and during the second year lateral branches occur 40-50 cm below the panicle, at the axile of the 3rd or 4th leaf and lower. In individuals under good conditions (e.g. from Mirtos river, Crete), the second-order branches bloom as well. Branching is a rare property in the *Gramineae* and Bell (1991: fig. 128) in his comprehensive book on plant morphology highlights this "unusual" property shared also by *Arundo donax*. Branching of the culm was also considered as a very important property in reed taxonomy by Scholz (in Greuter & Scholz 1996) when describing *Phragmites frutescens* H. Scholz (see also Scholz & Böhring 2000). By the second year, the up to 5 m long culm of *A. mediterranea* is already densely branched, in many cases carrying even two branches in each node (Fig. 1C).

In the field, *A. mediterranea* can furthermore instantly be distinguished among the six reed species in the Mediterranean (four *Arundo* and two *Phragmites* species) by the very limited length growth of its rhizomes, which produces individuals of caespitose growth (compare the diagrammatic presentation of caespitose grasses by Danin 1996: fig. 30, 31, 53, 54), being spatially separated from the other individuals of the population (Fig. 2A). In contrast to this "caespitose reed", "bunch reed", "tussock reed", or "tufted reed", the populations of the other five reeds look like true "rhizomatous reeds"; the distance among their orthotropic culms produced by the plagiotropic rhizome is several times the diameter of the orthotropic culms (Fig. 3A), resulting in spaced culms of one or more individuals covering larger areas. The innovation buds of *A. mediterranea* emerge from close to or from the base of the previous year's culm and tend to grow obliquely upright (Fig. 3B, and the front tuft in Fig. 2A). The peripheral culms of isolated *A. collina* patches may grow obliquely upright too. The new culms of the other four reed species emerge far enough from the old culms and have enough space to grow vertically, perpendicular to the rhizome.

*Arundo mediterranea* grows in rather deep alluvial clayey soils, in valleys, but not necessarily near permanent rivers (it is not a riparian plant), at elevation of 10-300 m. Most of its 19 populations I observed in Crete were confined to high terraces of temporary rivers, in a ground rich in pebbles.

*Additional specimens seen.* — ALGERIA: Env. d'Alger, 12.1846, *D. Clos* (G); Alger, marais de l'Arch. 6.1837, *N. Bové* (G); Alger, 9.860, *M. Planchon* (MPU); 1082 "*Arundo plinii*" Turra, Tizi – Ouzou, *Deflers* (MPU); El Biar Haies, 25.10.1875, *Trabut* (MPU); Oran, ravine blanc, 22.8.1882, *Debeaux* (MPU); W Algerie, département de Tlemcen, Gorges de la Tafna, 13.12.1965, *Sauvage* (MPU); Oued Mazafran, 30 km W of Algiers, littoral, 1-2 km of the sea, 15-20 m, 28.8. 2004, *A. Zeddam* (B,G, HUI, MPU). — CYPRUS: 12 km west of the new port of Limassol 15.5.2004, *Danin & Hadjikyriakou* (HUI) [published in Willdenowia 2004 as *A. plinii*]. — GREECE: Itea, near the road, 0.5 km N of Itea, at the margin of a dry watercourse, 3.12.2000, *Danin G2000/06* (HUI); Euboea, *T. Holzmann* [named by the collector *Arundo pliniana* Turra and determined by Boissier as *A. mauritanica*] (G-Boiss); Crete [of the 19 populations seen in October 2004]: Lassithi, Mirtos, high terrace of Mirtos river, alluvium rich in pebbles, 7.10.2004, *Danin & Zaffran* (HUI). — LEBANON: Beyrut, in maritimis, 29.10.1881, *Peyron* (G). — MOROCCO: Tanger, 1835, *Salzman* (MPU).

*Arundo collina* Tenore, Fl. Napolit. 3: 101, t. 108. 1822.

Type: not designated; for six specimens collected and annotated by Tenore (p.p. isotypes?), see below.

= *Arundo hellenica* Danin, Raus & H. Scholz in Willdenowia 32: 191-194. 2002.

*Arundo collina* as described in the protologue and represented by specimens collected by M. Tenore is clearly conspecific with *Arundo hellenica*. That we were tempted at all to describe *A. hellenica*, is because 10 years after its description Bertoloni (1833) regarded *A. collina* as synonymous with *A. plinii* and confused all later authors (e.g. Parlatore 1850, Fiori 1896-98, Rouy 1913, Coste 1937) when he selected Tenore's illustration of *A. collina* (Tenore 1824-29) for *A. plinii*. However, when visiting southern Italy in June 2004, I could see that the only *Arundo* species growing on slopes of the hills around Napoli (as stated in the description and on Tenore's labels), is the dwarf *Arundo*, which we earlier considered as the new species *A. hellenica*. Its most striking feature is that it forms monospecific patches over several to many hundred square metres each (Fig. 2B), or grows in ditches or mounds along rivers over large distances. These patches I have found so far on clayey slopes of southern Italy and Greece. It also re-grows in its primary habitats after olive were planted. *A. collina* is the most synanthropic of the three species related to *A. plinii*, even growing on clay near newly constructed roads in Italy and Greece. On disturbed ground near roads, a few years after colonization, the isolated individuals look like a caespitose grass, indicating that such populations became established by seed dispersal. *Dittrichia viscosa* was a common companion of the populations studied near Agios Stefanos, Greece.

*Selected specimens seen.* — ITALY: "In collibus circa Neapolim", *Tenore* (MPU); "in collibus Obria", "ab *A. mauritanica* Desf. haud diverse", *Tenore* (K); "colles circa Neapolitana, 1840", *Tenore* (G); "in collibus", "*Arundo collina*, N. [= nobis]", *Tenore* (G [herb. Moricand]); Rome, 1840, *Rayneval* (HUI); Rome, Magliana, near the metropolitan station, roadside slopes. 21.2. 2004, *Danin & Salerno* (HUI). — MAINLAND GREECE (see also the specimens listed under *A. hellenica* by Danin & al. 2002): Attica, Agios Stefanos, formerly disturbed ground near E75 road, together with *Dittrichia viscosa*, 6.10.2004, *Danin & Constantinidis* (B, E, G, HUI, K). — CRETE: Chania, near Sirili, c. 12 km W of Chania, formerly disturbed chalky-marly ground near the Tavronitis to Palaeochora road, 9.10.2004, *Danin & Zaffran* (HUI).

### The inflorescence and spikelet characters

The morphology of the lemma was considered by Danin & al. (2002) an important character to differentiate the taxa in *Arundo*, trusting, e.g., on the keen observers Maire & Weiller (1953) and Conert (1961), who mention for *A. plinii* of the Mediterranean a bifid lemma apex and do not have seen an entire lemma apex as in *A. hellenica*, the synonym of the earlier *A. collina*. After studying many specimens of the whole genus I came to the conclusion that only *A. donax* has a

clearly bifid lemma apex, the pair of teeth being 1-2 mm long; *A. plinii*, as understood by the present author, has such a pair of teeth of only 0.1-0.3(-0.8) mm length, which is thus hard to see and in many cases looks as an artefact, but is a good diagnostic character. *A. collina* and *A. mediterranea*, in contrast, have an entire lemma apex.

Otherwise the inflorescences of the four species do not provide diagnostic characters for their distinction. The long culms of the species, which are hard to press and preserve in herbaria, and the very similar inflorescences caused the taxonomic confusion. Disregard for the underground and basal plant parts, the general habit, the shape of populations and habitats of the taxa, and exclusive focus on the similar inflorescences are the reason for that good species like *A. mauritanica* and *A. collina* having been sunk into synonymy.

### Key to the Mediterranean *Arundo* species

1. Culms less than 2 cm in diameter, 0.5-5 m long; leaves upright, forming an angle of c. 30° with the culm, blades less than 30 mm wide; lemma with no or very short (< 1 mm) apical pair of teeth. . . . . 2
  - Culms 3-5 cm in diameter, up to 6(-10) m long; leaves clearly nodding, blades up to 60 mm wide; spikelet 12-18 mm, usually with 3 florets; lemma 8-10 mm long with two 1-2 mm long teeth at the base of the 2-4 mm long arista . . . . . *A. donax*
2. Population of isolated, caespitose individuals with obliquely erect culms (Fig. 2A); with sympodial rhizomes of limited extension and length (Fig. 3B) producing culms 1-5 m long, more than 12 mm in diameter and branched (Fig. 1B-C) even before the panicle is fully developed; plants of deep alluvial clayey soils, rich or poor in pebbles, not necessarily near water . . . . . *A. mediterranea*
  - Population of numerous vertical, spaced culms (Fig. 3A) from an extended rhizom, very rarely branched (if so then long after anthesis), resulting in lawn-like patches of several to many square metres; size and shape of the patches influenced by the local topography (e.g. ditches, river side, etc.); if individuals look caespitose, then culms 0.5-2(-3) m long and less than 7 mm in diameter . . . . . 3
3. Riparian plants (Fig. 1A), culms 1-2 m long; lemma with c. 0.1-0.3(-0.8) mm long teeth at the base of the arista . . . . . *A. plinii*
  - Plants of drier habitats, forming almost monospecific grasslands on hill slopes, especially in badlands on clay (Fig. 2B), high river terraces, and disturbed clayey ground at roadsides; lemma with entire apex . . . . . *A. collina*

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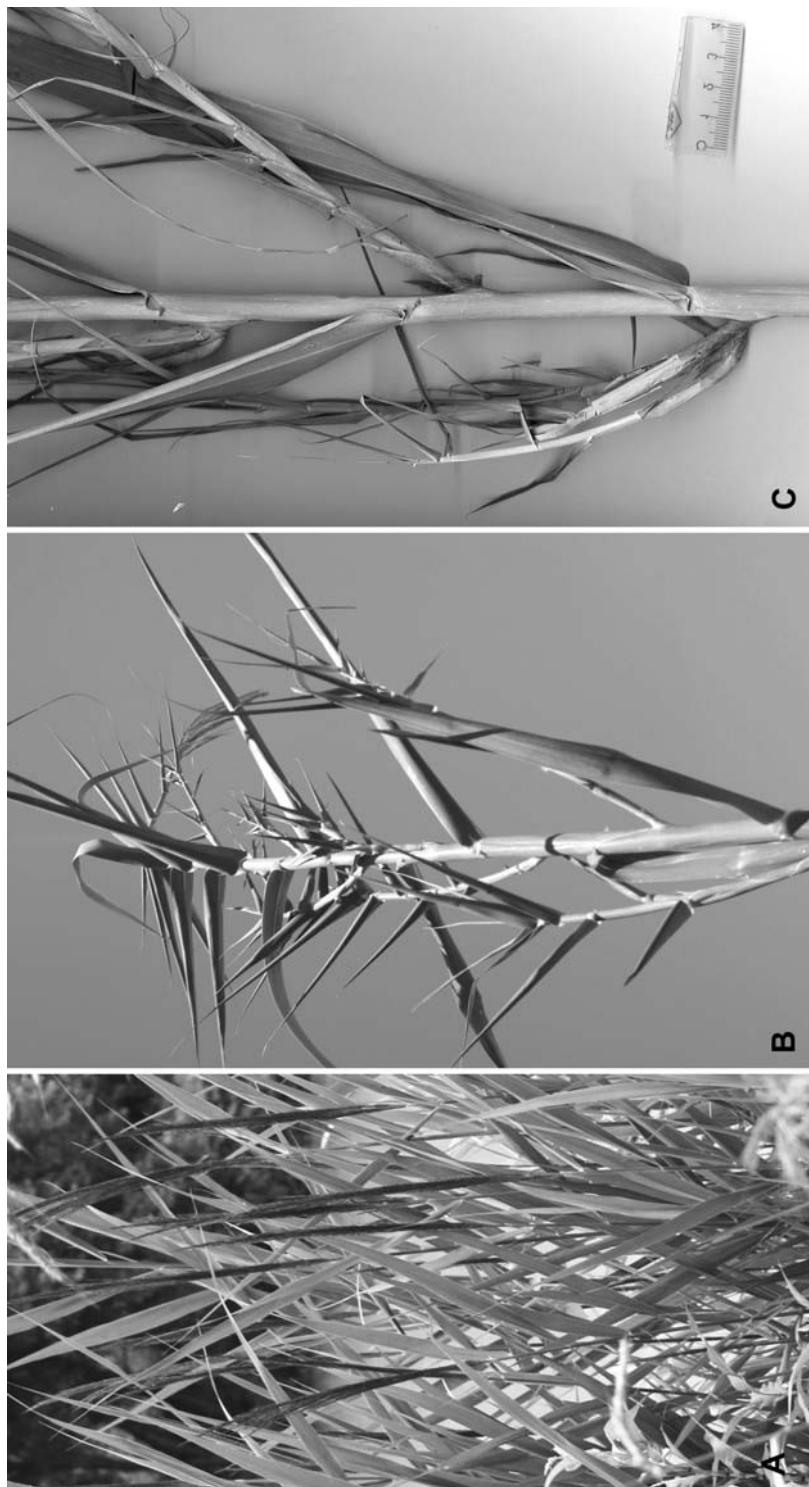


Fig. 1. A: *Arundo plinii* on the banks of Reno river, Bologne; B: *A. mediterranea* extravaginal tillers on a blooming culm. – C: *A. mediterranea* a branched culm with two- and one-year old branches.





Fig. 2. A: *Arundo mediterranea*, isolated tufts of “bunch-reed” with obliquely erect peripheral culms at the type locality in Israel. – B: *A. collina* forming a monospecific grassland, with a few *Spartium junceum* shrubs, on clay slopes at the catchment area of Biferno river, S Italy.

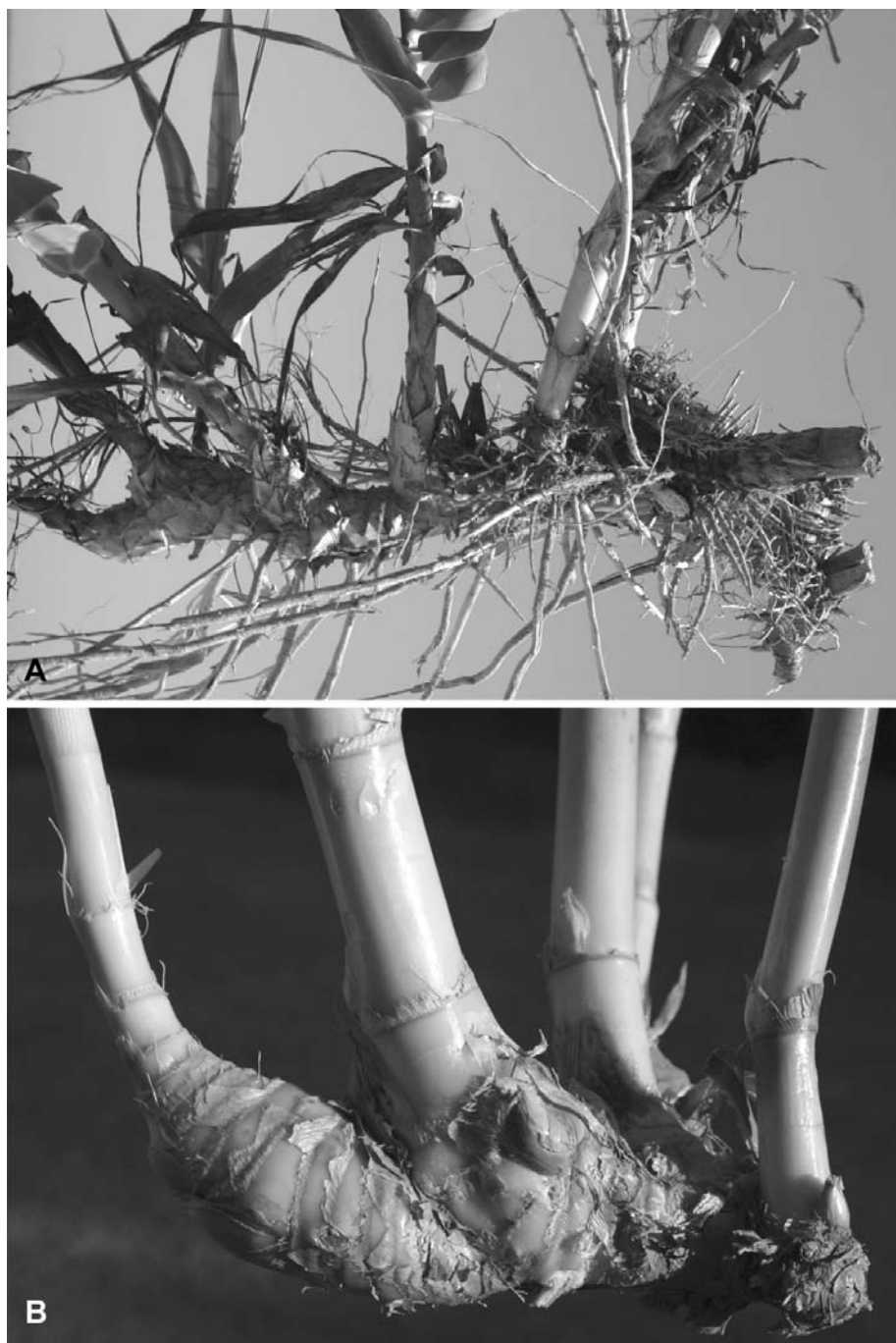


Fig. 3. A: *Arundo donax* rhizome with spaced orthotropic culms. – B: *A. mediterranea*, each culm has a 8-10 cm long pachyrhizome section, rich in buds, which may function as a corm; each of the three left culms emerged obliquely from the base of the older culm.