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Contribution to the recognition of reeds by their rhizome anatomy

Abstract

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Considerable differences in rhizome anatomy of the six reed species known from the Mediterranean area, may serve as excellent diagnostic characters which may be used to distinguish between *Phragmites* and *Arundo* species. There is an air-storing tissue (aerenchyma) of rectangular or rounded holes at the rhizome periphery of *Phragmites*. In the periphery of the *Arundo* rhizome there is a thick layer of parenchyma with occasional bundles of conducting elements. The solid pachyrhizomes of *Arundo donax* cannot be confused with those of the other reeds which are hollow.

Key words: *Arundo*, *Phragmites*, morphology.

Introduction

During ongoing comprehensive studies of reed distribution in the Mediterranean (Danin 2004; Danin & al. 2002, 2006) we tried to study the anatomy of leaves, stems, and rhizomes in order to find reliable diagnostic characters of anatomical or histological features. It is hard to find anatomical diagnostic characters in classical books dealing with *Gramineae* (Arber 1925; Eames & MacDaniels 1925; Clark & Fisher 1986; Fahn 1990). Functional studies concerning the aeration pathways (Armstrong & Armstrong 2006) can hardly assist comparative morphological studies of the reeds. Fortunately differences easy to see even without microscope have been detected. These differences make the recognition of non-blooming specimens very easy. Our first cross sections photographed by Dr. N. Ben-Eliahou were followed by thin sections made, stained, and photographed by the second author.

Materials and Methods

The following specimens, deposited in the herbarium of the Hebrew University of Jerusalem (HUJ), are the vouchers for our research:

Arundo plinii Turra,
Italy, Bologna, at the edge of Reno River. 27.7.2004, *Danin*.

Arundo mediterranea Danin

Israel, Philistean Plain, Nahal Sorek, 8 km east of Gadera, near Revadim. 18.9.2004, Danin.

Arundo collina Tenore

Crete, near Sirili, 20 km west of Chania. 8.10.2004, Danin & Zaffran.

Arundo donax L.

Israel, Dead Sea Valley, En Gedi, Nahal David. 18.10.2005, Danin.

Phragmites frutescens H. Scholz

Israel, Philistean Plain, Nahal Sorek, ca. 15 km SW of Tel Aviv. 18.9.2004, Danin.

Phragmites australis (Cav.) Trin. ex Steud.

Israel, Dead Sea Valley, En Gedi. 13.6.2006, Danin.

A direct photograph of a cross section in a rhizome is presented in Fig. 1. Photographs of cross sections made through dissecting microscope are presented in Fig. 2, 6, 9, and 10.

In order to produce thin sections, rhizomes were collected in the field into plastic bottles with a 2/3 water and 1/3 ethanol 70%. They were then handled by the second author (W.N.) who used a microtome to produce cuts 25-30 μ thick. They were stained in most cases with ETZOLD-mixture. Components of the ETZOLD-mixture are: Fuchsin, Safranin, Astrablue, and Acetic Acid. Fig. 4 was stained with Acridinorange. Polarization was used in viewing and photographing Figs. 3, 4, and 7; bright field was used in viewing and photographing Figs. 5 and 8.

Results

The most significant difference among members of the reeds group is the presence of an air-storing tissue (aerenchyma) of rectangular holes, in cross-section, at the rhizome periphery of *Phragmites australis*, and of rounded holes in *P. frutescens* (Figs. 1-5). No such tissue is found in any of the four species of *Arundo*. Studies in herbaria (HUJ, K, G, PAL, MPU) revealed that *Phragmites australis* specimens from all continents share the diagnostic property of the rhizome.

The three species of *Arundo* related to *A. plinii* (including *A. collina* and *A. mediterranea*) have rhizomes which resemble that of Fig. 6-1 in the longitudinal folds seen on the surface. They also resemble each other in their peripheral parenchyma clearly seen in Figs. 6-3, 6-4, 8, and 9. A layer of parenchyma of this kind is not found in any of the two *Phragmites* species. *Arundo donax* has a thick, solid pachyrhizome displayed in Fig. 10 and does not resemble any of the other taxa mentioned above which share hollow rhizoms.

One aerial stem of a reed is presented in Fig. 6-2. All taxa studied here have such a stem and it cannot serve in its anatomy to the recognition of species. Leaves are seen in the cross section in Fig. 7 and display the thick veins, each with a single bundle, differing by the thickness of their fiber layer subtending the tracheal elements.

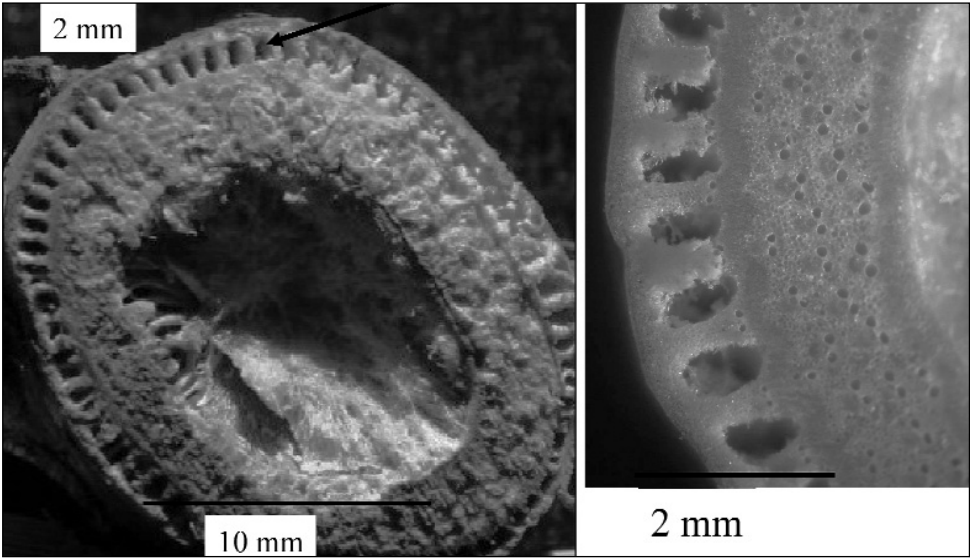


Fig. 1. A cross-section of a rhizome of *Phragmites australis*.

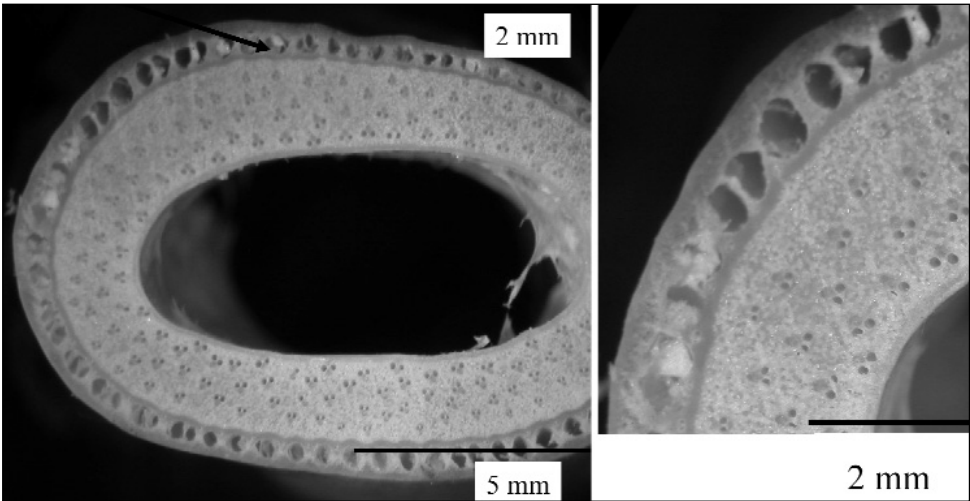


Fig. 2. A cross-section of a rhizome of *Phragmites frutescens*.

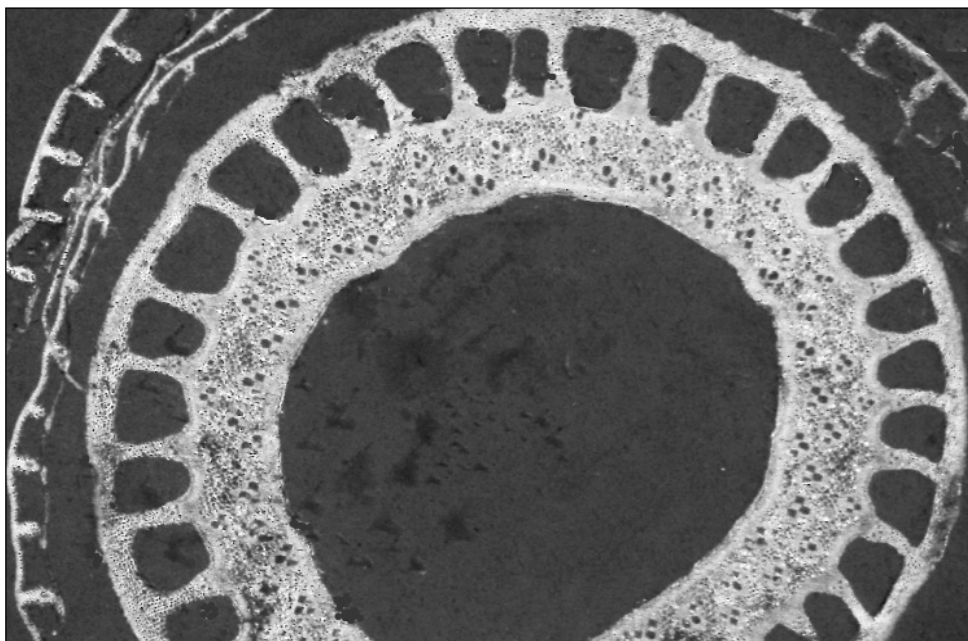


Fig. 3. Microscopic cross-section of a young rhizome of *Phragmites australis* subtended by two leaves.

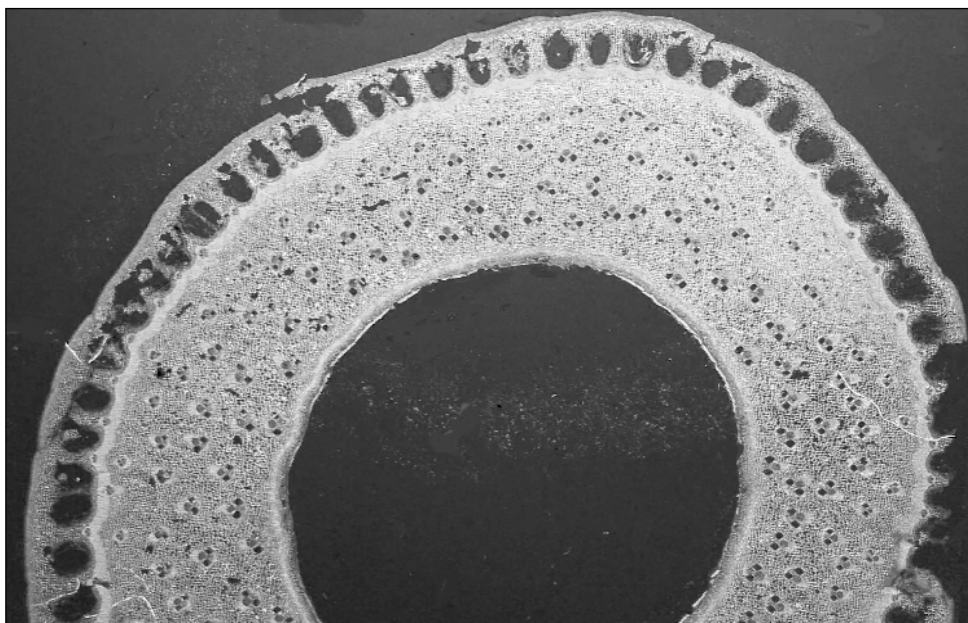


Fig. 4. Microscopic cross-sections of a rhizome of *Phragmites frutescens*.

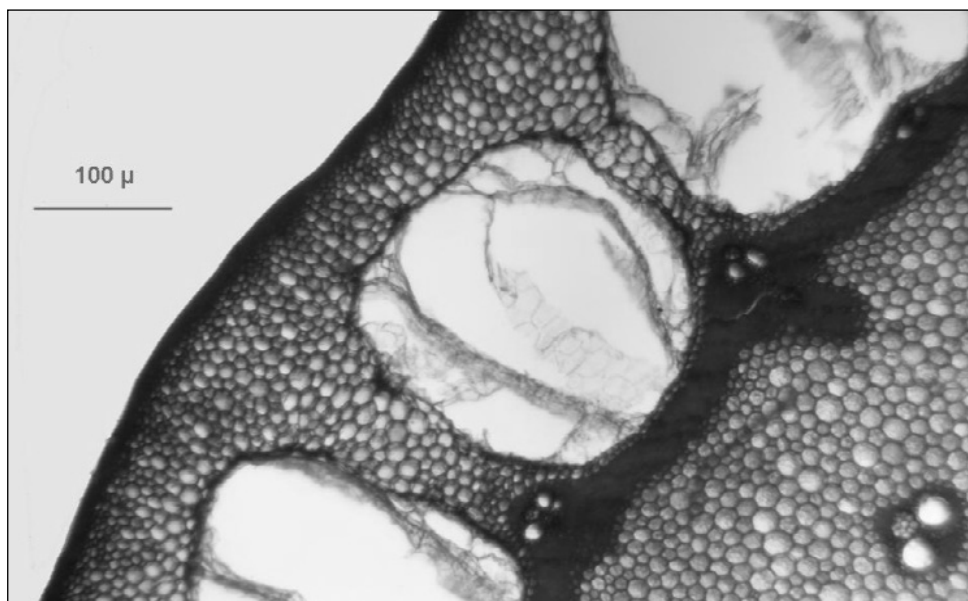


Fig. 5. A thin microscopic cross-section of a rhizome of *Phragmites frutescens*. Note the large cells of the aerenchyma filling the holes.

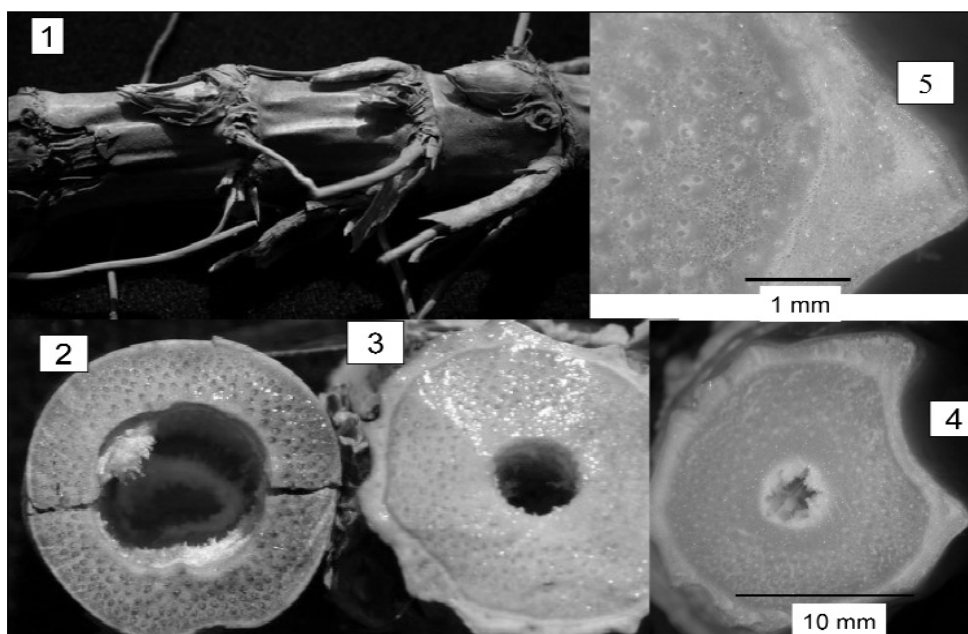


Fig. 6. *Arundo mediterranea*: 1, A dry rhizome; 2, A cross section of a stem high above the ground; 3, 4, 5, Cross-sections of rhizomes.

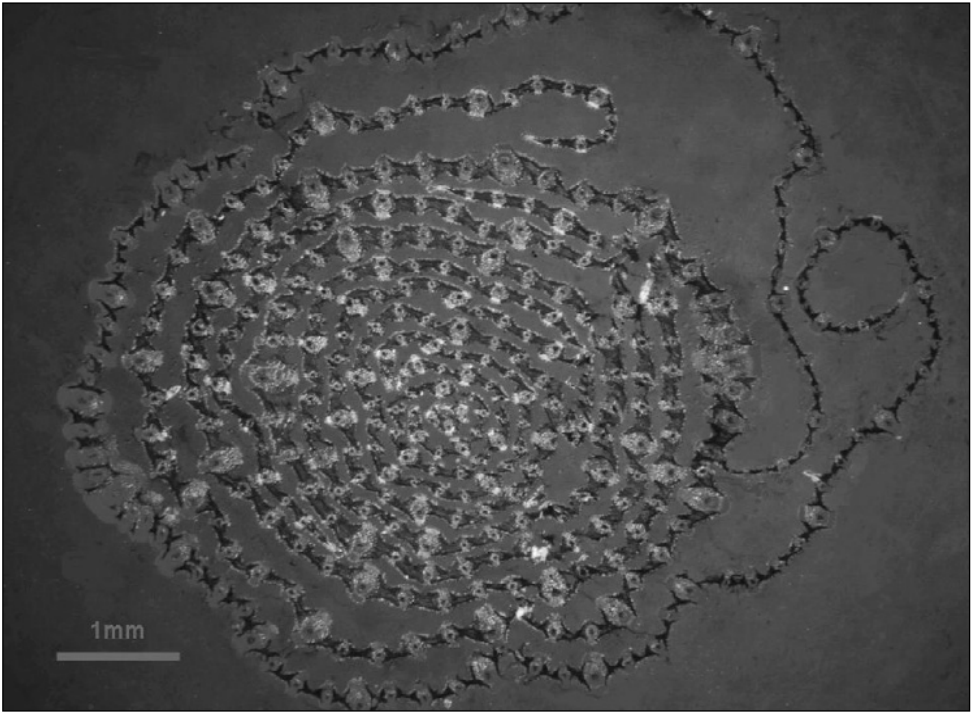


Fig. 7. A cross-section of an aerial shoot of *Arundo mediterranea* at 1 m height displaying veins with a single bundle.

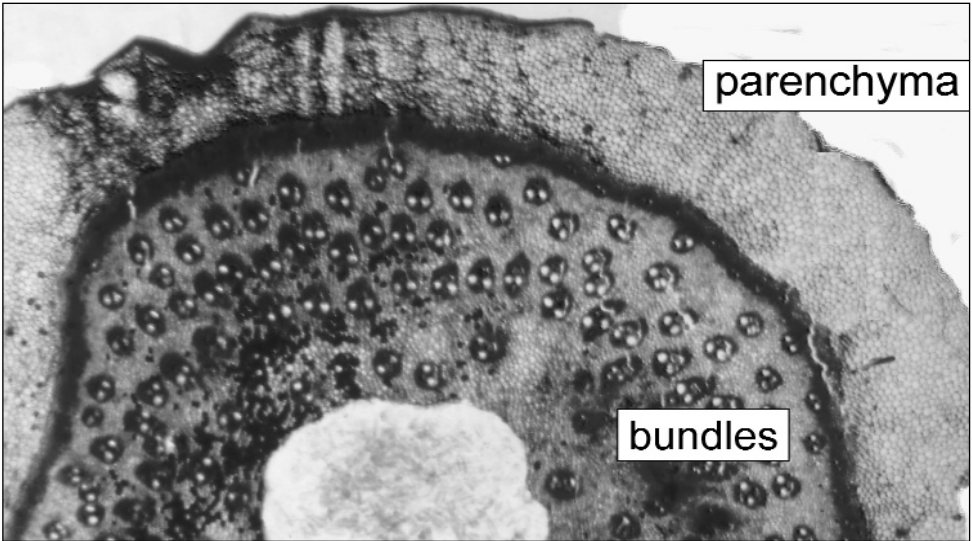


Fig. 8. Microscopic cross-section of a rhizome of *Arundo plinii* from the “locus classicus”.

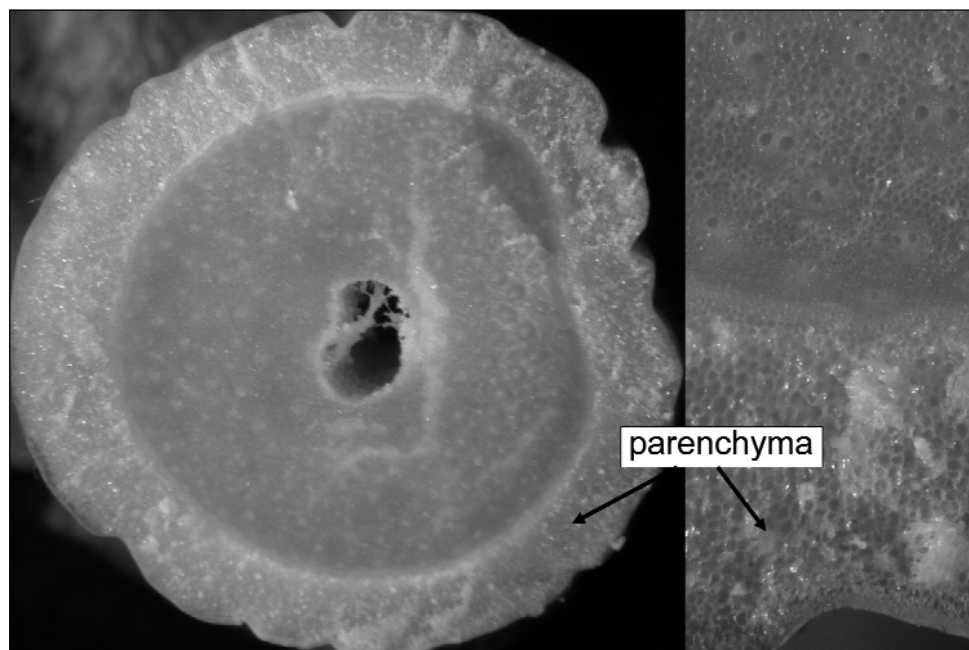


Fig. 9. Cross-sections of rhizomes of *Arundo collina*.

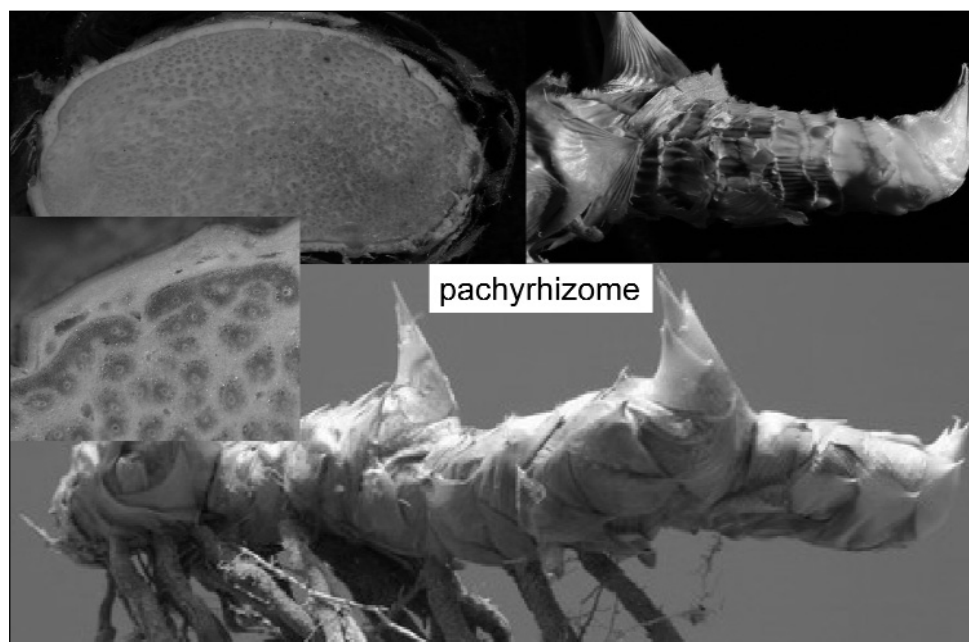


Fig. 10. Cross-section of the pachyrhizome of *Arundo donax*.

Conclusions

The differential properties of the general rhizome anatomy of reeds enable one to recognize the species involved even when they do not bloom or bear inflorescences. A following key can corroborate the conclusions as follows:

1. Rhizome solid, several times thicker than the vertical stems.....*Arundo donax*
– Rhizome hollow, about the same diameter as the vertical stems.....2
2. Rectangular or ovoid holes present at the peripheral layer of underground stems (horizontal and vertical) as seen in the cross-section.....3
– Holes absent at the periphery of cross-sections of the underground stems.....*Arundo plinii*, *A. collina*, and *A. mediterranea*
3. Holes of the air-storing tissue rectangular.....*Phragmites australis*
– Holes of the air-storing tissue oval or rounded..... *P. frutescens*

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