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Autor(en): **Peroni, Adalberto / Peroni, Gabriele**

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Epidermiological Notes on *Cyrtomium falcatum* (L. fil.) C. Presl and *C. fortunei* J. Sm. (Pteridophyta: Dryopteridaceae)

Adalberto Peroni – Gabriele Peroni

Museo Insubrico di Storia Naturale, P.zza Giovanni XXIII 4, I-21056 Induno Olona (VA)

Abstract: We have carried on an epidermic study on *Cyrtomium falcatum* (L. fil.) C. Presl and *C. fortunei* J. Sm. We have considered the length and width of stomata and epidermic cells. On the ground of these results, micromorphological characteristics can contribute to correct the identification in critical cases or when the spores are not available.

Riassunto – Gli autori hanno effettuato uno studio epidermiologico su *Cyrtomium falcatum* (L. fil.) C. Presl e *Cyrtomium fortunei* J. Sm. considerando la lunghezza e la larghezza degli stomi e delle cellule epidermiche. Le caratteristiche micromorfologiche possono contribuire ad una corretta identificazione nei casi critici o quando le spore non sono disponibili.

Key words: PTERIDOPHYTA, Epidermiology, DRYOPTERIDACEAE, *Cyrtomium falcatum*, *Cyrtomium fortunei*.

INTRODUCTION

The genus *Cyrtomium* C. Presl belongs to the DRYOPTERIDACEAE family and consists about of 15-25 species whose general distribution is: Asia, Africa - Madagascar included, North America and the Hawaii Islands (TRYON & TRYON, 1982; TRYON & LUGARDON, 1990; YATSKIEVYCH, 1993b).

Cyrtomium, *Polystichum* Roth and *Phanerophlebia* C. Presl form a very similar group and the relationships among the three genera are not completely well-known yet (see also YATSKIEVYCH, 1993 b).

In fact, *Cyrtomium* is a genus which requires systematic and close examinations (YATSKIEVYCH, 1993) and, according to some authors, it has to be considered a subgenus of *Polystichum* Roth (i.e. KRAMER in KRAMER & GREEN, 1990; KRAMER *et al.*, 1995).

YATSKIEVYCH (1993a), dealing with *Phanerophlebia*, wrote: «*Phanerophlebia* is sometimes included in *Cyrtomium*, which it resembles superficially. As that genus, *Phanerophlebia* might better be considered a subgenus of *Polystichum*, from which it is poorly differentiated morphologically».

MICKEL & BEITEL (1988) noticed that *Phanerophlebia* «is supposedly distinct from *Cyrtomium* on the basis of free vs. netted veins but some *Phanerophlebias* have netted veins and some *Cyrtomiums* have free veins».

The following chromosomal numbers are referred to *Cyrtomium* genus: n=41, n=82 and n=123 apogamus (CHIARUGI, 1960; LOVE *et al.*, 1977; TYRON & TYRON, 1982).

Two species are naturalised in Europe: *Cyrtomium falcatum* (L. fil.) C. Presl and *C. fortunei* J. Sm.

C. falcatum has a very broad distribution in hot areas,

above all in rocky areas close to the sea; *C. fortunei* is an Asiatic plant widespread from the Southeast of China to Japan and Korea. (EDIE, 1978)

Both species are apogamus with n=2n=123.

In Europe *C. fortunei* is indicated in the Azores Islands and naturalised in Switzerland and Italy (PIGNATTI *et al.*, 1983; PERONI & PERONI, 1997) while *C. falcatum* is naturalised in the Azores Islands, Belgium, Great Britain, France, Ireland and Italy (DERRICK *et al.*, 1987; AKEROYD in TUTIN *et al.*, 1993; BONAFEDE *et al.*, 1993; HUTCHINSON & THOMAS, 1996).

Sometimes, these two species have been confused and, to better define their individual characteristics, we did an epidermic and palynological study.

MATERIALS AND METHODS

One hundred spores of *C. falcatum* and *C. fortunei* have been measured immersing the sporal material in a 50% of H₂O and glycerol and observed by a Will Wilomed microscope at a magnification of x400.

The method, illustrated by VIANE (1990) and with some variations suggested by PERONI & PERONI (1996), has been adopted for the epidermic test: some pinnules have been immersed in a 25% solution of NaOH for 24 hours and then re-washed under running water for about one hour.

After having been washed in distilled water they have been placed in a 270 ml solution of 95% ethanol, 105 ml of distilled water, 120 ml of glycerol and 20 drops of formalin.

The samples have been coloured with a water solution of Ruthenium Red in order to be examined under the microscope and in this way they have been observed by an

Olympus BX-40 microscope and photographed by Nikon F-90 camera using photosensitive Kodak film.

We referred to VAN COTTHEM (1970) for the description of the stomata features.

All the specimens examined are kept in the herbarium of the Museo Insubrico di Storia Naturale di Induno Olona (Varese - Italy) and in the authors' herbarium.

Specimens examined:

Cyrtomium falcatum (L. fil.) C. Presl

- Switzerland, Cantone Ticino, Brissago: Isola di S. Pancrazio, 03.07.1994, leg. Bonalberti C., Peroni A. & G., det. Peroni A. & G., Herb. Peroni n° 441.
- Madeira, S. Vicente, about 500 m, 28.06.1997, leg. Bonalberti C. & Peroni G., det. Peroni A. & Peroni G., Herb. Peroni n° 708 m.

Cyrtomium fortunei J. Sm.

- Italy, Piemonte, Pombia (Novara), 01.05.1991. leg. Bonalberti C., Peroni A. & G., det. Peroni A. & G., confirm. Kramer K.U., Herb. Peroni n°109 and n°137; Herb. Museo Insubrico di Storia Naturale, Induno Olona n° 1166.
- Switzerland, Cantone Ticino, Lugano, 09.09.1991, leg. e det. Peroni A. & G., Herb. Peroni n° B156.
- Italy, Lombardia, Laveno Mombello (Varese), 23.04.1997, leg. Danini G., det. Peroni A. & G., Herb. Peroni n° 705 m.

RESULTS AND DISCUSSION

Macroscopically, *Cyrtomium falcatum* has 4-10 pairs of pinnae, which are leathery, shiny adaxially, with sometimes undulate or coarsely dentate, but never minutely crenulate or denticulate margins.

C. fortunei has 10-25 pairs of papery, not shiny adaxially pinnae with minutely crenulate-denticulate margins (YATSKIEVYCH, 1993a).

An important characteristic useful to distinguish *C. falcatum* from *C. fortunei* is the indusium, which is shrivelled at maturity in *C. fortunei*, while it is not in *C. falcatum*.

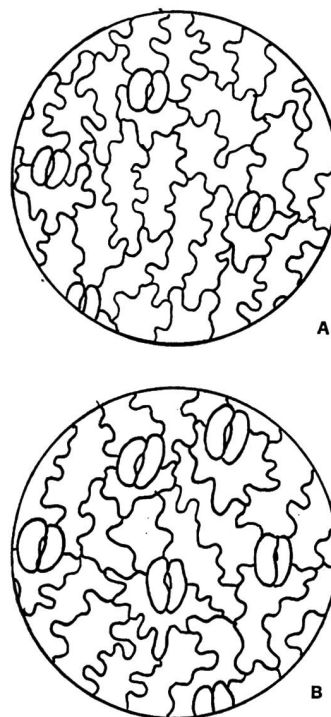


Fig. 1. Epidermis of: A *Cyrtomium falcatum* and B *Cyrtomium fortunei*.

TRYON & LUGARDON (1990), studying the spores of nine specimens of this genus, give varying dimensions from 30 up to 47 mm specifying: « Several species, as *C. falcatum* (L. fil.) Pr., *C. fortunei* J. Sm. and *C. caryotideum*, are reported as apogamous triploids with a chromosomal number of n=123. The large spore of the latter from China reflects this condition.»

HUANG (1981), about material from Taiwan, reports dimensions of 27-37 µm for *C. falcatum* while gave 30-35 µm for *C. caryotideum* (Wallich) Presl, and ZHANG *et al.* (1990) reports for *C. fortunei* 42.5 - 50 µm on chinese materials.

According to our measurements, it results that the two taxa have really similar sporal dimensions, even if they are a little bit bigger in *C. fortunei* (see Tab.1).

Morphologically they seem to be monolet spores that, by the optical microscope, appear with irregularly tuberculate perine in *C. falcatum*, while in *C. fortunei* the processes are more rounded and regular.

Species	2n	Spores in µm	Stomata length in µm	Stomata width in µm	Stomatal types	SI/Sw mean
<i>C. falcatum</i>	123	27-39	(33)-37.26-(48)	(21)-23.94-(30)	P (14% A)	1.55
<i>C. fortunei</i>	123	30-42	(42)-49.65-(60)	(27)-31.50-(36)	P (4% A)	1.57

Tab. 1 - Some microcharacteristics of *Cyrtomium falcatum* and *Cyrtomium fortunei*.

A: anomocytics.

P: polocytics.

Species	Abaxial side				Adaxial side	
	Subsidiary cells		Epidermic cells		Epidermic cells	
	Length	Width	Length	Width	Length	Width
<i>C. falcatum</i>	(39)-53.22-(63)	(45)-53.58-(72)	(60)-86.40-(120)	(36)-48.24-(66)	(54)-84.42-(111)	(30)-36.80-(48)
<i>C. fortunei</i>	(54)-69.42-(87)	(57)-77.73-(108)	(78)-129.33-(159)	(45)-56.91-(72)	(69)-104.1-(135)	(36)-47.22-(63)

Tab. 2 - Characteristics of foliar epidermal cells of *Cyrtomium falcatum* and *Cyrtomium fortunei* in µm.

The stomata are above all polocytics with a certain percentage of anomocytics that arrives to 14% in *C. falcatum*.

In *C. falcatum* we noticed about 2% of crossed stomata with an inclination up to 90° and 1-2% of adjacent stomata.

The length and width of the stomata (Tab. 1) belonging to the subsidiary and epidermic cells (Tab. 2), of both species, are appreciably different, allowing in this way an easy distinction also in those cases where the macroscopic characteristics are dubious or where the spores are not available.

In a recent work about the European species of *Polystichum* genus (PERONI & PERONI, 1996), the comparison of the epidermiological characteristics between *Polystichum* and *Cyrtomium* confirms the close relation between the two genera.

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