Phytotaxa 237 (1): 001–067
www.mapress.com/phytotaxa/

Monograph

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

http://dx.doi.org/10.11646/phytotaxa.237.1.1

PHYTOTAXA

237

Spore morphology of *Selaginella* (Selaginellaceae) from China and its systematic significance

XIN-MAO ZHOU[1, 2, 3], LI-JÜ JIANG[1], LIANG-ZHANG[2], XIN-FEN GAO[2], ZHAO-RONG HE[1, *] & LI-BING ZHANG[4, *]

[1]*School of Life Science, Yunnan University, Kunming, Yunnan, 650091, China.*
[2]*Chengdu Institute of Biology, Chinese Academy of Sciences, P.O. Box 416, Chengdu, Sichuan 610041, China.*
[3]*School of Life Sciences, Sichuan University, Chengdu, Sichuan 610064, China*
[4]*Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.*
**Authors for correspondence: zhrhe@ynu.edu.cn; Libing.Zhang@mobot.org*

Magnolia Press
Auckland, New Zealand

Accepted by Marcus Lehnert: 5 Oct. 2015; published: 4 Dec. 2015

XIN-MAO ZHOU, LI-JÜ JIANG, LIANG-ZHANG, XIN-FEN GAO, ZHAO-RONG HE & LI-BING ZHANG
Spore morphology of *Selaginella* (Selaginellaceae) from China and its systematic significance
(*Phytotaxa* 237)

67 pp.; 30 cm.

4 December 2015

ISBN 978-1-77557-847-5 (paperback)

ISBN 978-1-77557-848-2 (Online edition)

FIRST PUBLISHED IN 2015 BY

Magnolia Press

P.O. Box 41-383

Auckland 1346

New Zealand

e-mail: magnolia@mapress.com

http://www.mapress.com/phytotaxa/

ISSN 1179-3155 (Print edition)

ISSN 1179-3163 (Online edition)

ABSTRACT

Using light microscope (LM) and scanning electron microscope (SEM), the megaspores and microspores of 77 samples representing ca. 70 species of *Selaginella* from China are observed. Combing previous studies, the spore morphology of nearly all documented *Selaginella* species from China were reviewed. Based on the morphological characteristics in megaspores and/or microspores, we divided the spores of Chinese species into 15 types and three types are further divided into various subtypes. Each type and subtype are described in detail and a key to the types and subtypes of spores is given. For the first time, the systematic significance of microspores of *Selaginella* are discussed, and the results indicate that microspores of *Selaginella* are significant in the systematics of *Selaginella*. Some important morphological characteristics in spores (e.g., color, micro-sculpture, size, etc.), often been neglected in previous studies, are introduced. Some spore-morphological synapomorphies of the clades and subclades, identified by recent molecular work (Zhou *et al.* 2015a), are well established. Using the spore morphology, the delimitation of some taxonomically difficult species in *Selaginella* is assessed.

Key words: Micro-sculpture, macro-morphology, spore color, ornamentation, spore size, laesurae, Flora of China, Phylogeny

Introduction

With one genus of about 800 species (Zhou & Zhang, in press), Selaginellaceae are the largest family in lycophytes. Members of Selaginellaceae are worldwide distributed and predominantly in the tropics (Tryon & Lugardon 1991, Zhou *et al*. 2015a). The family is monophyletic and sister to *Isoëtes* Linnaeus based on morphology (Kenrick & Crane 1997) and molecular analyses (Kranz & Huss 1996, Wikström & Kenrick 1997, Korall *et al.* 1999, Zhou *et al.* 2015a).

Morphologically, plants of *Selaginella* Beauvois are small in size and taxonomic characteristics available are few. High intraspecific and low interspecific variation is often present in *Selaginella* (Korall & Taylor 2006, Schulz *et al.* 2013). Moreover, most morphologically similar species usually share same habitats (Zhang *et al.* 2013). All of these factors not only make species of *Selaginella* difficult to identify, but also easy to be confused (Banks 2009, Gu *et al.* 2013, Schulz *et al.* 2013). Meanwhile, infrageneric classifications (e.g., Spring 1850, Hieronymus & Sadebeck 1901, Walton & Alston 1938, Jermy 1986) and the delimitation of species (e.g., Baker 1887, Tryon 1955, Zhang *et al.* 2013) are always controversial in *Selaginella*.

Species of S*elaginella* are heterosporous and possess megaspores and microspores. Relative to vegetative characters, spore morphology is more stable and informative (Alston *et al.* 1981). It also has been proven by vast amounts of observations and studies in *Selaginella* (references see below). In the early years, the observations of spores in *Selaginella* were mainly carried out under light microscope (LM). Using LM, Zhang *et al.* (1976) observed microspores of 21 Chinese species and divided them into five types (baculate, granulate, spine, tuberculate and verrucate) on the basis of the surface sculptures of exospore. Huang (1981) described megaspores and microspores of 14 species from Taiwan in detail and provided a key to species based on spore morphology. Chu (2006) observed and described the color and surface morphology of megaspores and microspores of *Selaginella* from Yunnan which harbors the most species of *Selaginella* in China. Using scanning electron microscope (SEM), megaspores and microspores of species of *Selaginella* worldwide were extensively studied (e.g., Reeve 1935, Hellwig 1969, Minaki 1984, Heusser & Peteet 1988, Liu *et al.* 1989, Liu & Bao 1990, Tryon & Lugardon 1991, Giorgi *et al.* 1997, Stefanović *et al.* 1997, Liu *et al.* 2001, Chang *et al.* 2002a, Chang *et al.* 2002b, Liu *et al.* 2002, Sun *et al.* 2002a, Sun *et al.* 2002b, Li *et al.* 2003, Liu *et al.* 2003, Liu & Yan 2004, 2005, Korall & Taylor 2006, Liu *et al.* 2006, Zhao *et al.* 2006a, Zhao *et al.* 2006b, Zhu *et al.* 2006, Zhou *et al.* 2012, Schulz *et al.* 2013, Xia *et al.* 2013, Singh *et al.* 2014, etc.). Of those works, generally, one or more species were examined and described. However, except Minaki (1984), Korall & Taylor (2006), and Schulz *et al.* (2013), taxonomic significances of spore were rarely discussed comprehensively in *Selaginella*. Minaki (1984) observed megaspore surfaces and wall structure of 37 Asian species (mainly from Japan) and one Australian species, and divided the megaspores of the species sampled into four types and 19 subtypes. Some of the megaspore types or subtypes correspond to the taxa or groups defined by Walton & Alston (1938). Korall & Taylor (2006) examined the megaspore morphology and wall structure of 52 species. Combining their previous phylogenetic studies (Korall *et*