

Spore studies in the genus *Gymnocarpium*

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Scanning electron microscopy was used to examine the variation in perispore characters within and between six currently recognized taxa of the genus *Gymnocarpium* Newm. in North America. Representative scanning electron micrographs are presented and depict the perispore features observed. Spores of those taxa studied here do not each possess a distinctive morphology providing practical species discrimination, rather they all exhibit similar patterns of variation. Spore size was also examined and shown to be correlated to ploidy level, permitting positive identification of the diploid taxon *G. dryopteris* ssp. *disjunctum* from the tetraploid *G. dryopteris* ssp. *dryopteris*.

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La microscopie électronique à balayage a été utilisée pour étudier la variation des caractères de la périspore dans six taxons du genre *Gymnocarpium* Newm. en Amérique du Nord. Des micrographies au MEB sont présentées et illustrent les caractéristiques observées sur les périspores. Les taxons étudiés ici ne possèdent pas tous, au niveau de la périspore, des caractères morphologiques distinctifs permettant une séparation pratique des espèces, mais ils montrent plutôt des patrons de variation semblables. La dimension des spores a également été examinée; elle est corrélée avec le niveau de pléidie et elle permet donc de séparer le taxon diploïde *G. dryopteris* ssp. *disjunctum* du tétraploïde *G. dryopteris* ssp. *dryopteris*.

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Introduction

In his study of Fennoscandian fern species, Sorsa (1964) surveyed the spores of two species of *Gymnocarpium*, *G. dryopteris* (L.) Newm. and *G. robertianum* (Hoffm.) Newm., with light microscopy and provided measurements for the spores as well as descriptions of the perine sculpture. According to his study, the spores of *G. dryopteris* were saccate (the sacchi sometimes lengthened into folds), and the perine surface was foveo-reticulate. The perine sculpture of *G. robertianum* was also saccate and the surface was described as psilate to punctate-foveolate or irregularly foveo-reticulate. These two species were again included in a pteridophyte spore study by Erdtman and Sorsa (1971) and the perine surface descriptions given for these two taxa closely matched those by Sorsa (1964).

At the same time as the present investigation, a parallel study of the spore morphology and spore sizes of *Gymnocarpium* was being conducted in Finland by Sorsa (1980), a colleague of J. Sarvela who has recently revised the genus (1978) on the basis of European, Asiatic, and American material. Using both light and scanning electron microscopy, the exospore and perispore characters of the spores of 8 of the 11 taxa recognized by Sarvela were studied. On the basis of perispore characters, Sorsa divided the taxa into two groups which corresponded with Sarvela's groupings of the genus based on gross vegetative morphology. In

addition, Sorsa considered perispore characters to be of diagnostic value at the specific and subspecific level.

The genus *Gymnocarpium* in North America has recently been the subject of systematic study (Pryer 1981). In this treatment six taxa are recognized as follows: *G. dryopteris* (L.) Newm. ssp. *dryopteris*; *G. dryopteris* (L.) Newm. ssp. *disjunctum* (Rupr.) Sarvela; *G. robertianum* (Hoffm.) Newm.; *G. jessoense* (Koidz.) Koidz. ssp. *parvulum* Sarvela; *G. dryopteris* (L.) Newm. ssp. \times *brittonianum* Sarvela, and *G. \times intermedium* Sarvela. With an emphasis on North American material, the spore characteristics of these taxa were considered in detail using scanning electron microscopy (SEM). The variation in perispore patterns was examined critically within and between all taxa with a view to assessing its taxonomic significance, particularly in the light of the claims made by Sorsa (1980).

Spore size has been shown to be significantly correlated to ploidy level in several fern genera (Manton 1950; Lovis 1964; Wagner and Chen 1965; Whittier 1970). Brown (1964) and Britton (1968), however, working on *Woodsia* and *Dryopteris*, respectively, were unable to show any size differences between spores of some tetraploid taxa and those of closely related diploid species.

Different ploidy levels are known to occur in *Gymnocarpium*. Chromosome counts of $n = 80$ for the tetraploid taxa, *G. dryopteris* ssp. *dryopteris* and *G. robertianum*, and $n = 40$ for the diploid *G. dryopteris* ssp. *disjunctum* and *G. jessoense* (Koidz.) Koidz. ssp.

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