

**MORPHOLOGICAL AND ANATOMICAL VARIATIONS
AMONG THE GENERA OF GLEICHENIACEAE**

By

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**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
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Chairman: Associate Professor Rusea Go, PhD

Faculty: Science

A research of morphological and anatomical variation among the genera of Gleicheniaceae in Peninsular Malaysia was carried out from June 2003 to May 2005. Eighteen species of Gleicheniaceae (including 9 varieties) from 4 genera namely 9 species of *Dicranopteris*, 3 species of *Diplopterygium*, 3 species of *Gleichenia* and 3 species of *Sticherus* had been examined. These ferns were collected from the fringes of the Lowland Dipterocarp Forest (LDF), Hill Dipterocarp Forest (HDF), Lower Montane Forest (LMF) and Upper Montane Forest (UMF). All species of Gleicheniaceae are sun-ferns that grow well on poor clay soils or nutrient poor soil with small demand of mineral substances. They make adaptation by their creeping rhizomes and by the indefinite growth of the fronds that form thickets. Morphological studies including frond architecture and study of stipe anatomy were conducted, as they are taxonomically significant for delimiting genera and species within Gleicheniaceae. Six types of frond architecture (including the modification from the basic) were observed in this study with each corresponding to a distinct genus and also to certain species. Furthermore, the characters of the dermal appendages (hairs and scales) at the stipe, costae and costules of the lamina segments are found to be significant for delimiting of species in the genera. The

presence of additional branches and the shape of pseudostipules, size, texture, the condition of the upper or lower surface of the lamina segments and venation pattern were the basis for the classification of genera and some species. The stipe anatomy revealed that Gleicheniaceae has three types of vascular bundle in the stele. The C-shaped form was found in genera *Dicranopteris* (excluding *D. linearis* var. *linearis*), *Diplopterygium* and *Sticherus*; circular-shaped vascular bundle was found in genus *Gleichenia* whereas D-shaped vascular bundle was found in only one species of *Dicranopteris*, namely the *D. linearis* var. *linearis*. The features such as the distribution of endodermis, different width of the adaxial gap, different forms of the adaxial hooks and different amount and distribution of xylem and protoxylem groups are important for identification. Variation in the vascular bundle of Gleicheniaceae was found to be taxonomically significant at the genus and species levels.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

**MORFOLOGI DAN VARIASI ANATOMI
TERHADAP GENERA FAMILI GLEICHENIACEAE**

Oleh

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Kajian morfologi dan anatomi batang terhadap paku-pakis bagi famili Gleicheniaceae telah dijalankan di Semenanjung Malaysia antara Jun 2003 hingga Mei 2005. Daripada kajian ini, sejumlah 18 spesies termasuk 9 varieti Gleicheniaceae yang tergolong dalam empat genera yang bernama *Dicranopteris* (9 spesies), *Diplopterygium* (3 spesies), *Gleichenia* (3 spesies) dan *Sticherus* (3 spesies) telah diteliti. Paku-pakis ini biasanya ditemui di pinggir Dipterokarp tanah pamah (LDF), Dipterokarp peringkat tinggi (HDF), hutan hujan gunung peringkat rendah (LMF) dan hutan hujan gunung peringkat tinggi (UMF). Semua spesies Gleicheniaceae suka terhadap pendedahan cahaya matahari; hidup subur di tanah liat atau tanah yang kurang nutrien serta keperluannya terhadap nutrien adalah sedikit. Ia membentuk semak atau belukar yang tebal dengan pengubahsuaian rizomnya yang menjalar serta pertumbuhan pelepah yang berulang-ulang. Kajian morfologi termasuk corak percabangan serta kajian anatomi batang telah dijalankan adalah bererti secara taksonomi untuk membatasi atau membezakan genus dan spesies Gleicheniaceae. Enam jenis corak percabangan (termasuk modifikasi daripada yang asas) telah dikenalpasti daripada kajian ini dan setiap satu dapat

memberikan gambaran yang jelas kepada genus ataupun sesetengah spesies. Tambahan pula, kehadiran rambut atau/ dan sisik pada batang, urat tengah dan petiol pada daun adalah ciri-ciri taksonomi penting bagi spesies dalam genera. Kehadiran cabang daun tambahan, rupa bentuk “pseudostipules”, tekstur, saiz, rupa bentuk dan keadaan permukaan atas dan bawah daun urat daun merupakan ciri asas bagi pengkelasan genera dan beberapa spesies. Kajian anatomi batang pula menunjukkan bahawa Gleicheniaceae mempunyai tiga jenis bentuk berkas vaskular dalam stel iaitu bentuk-C dalam genera *Dicranopteris* (selain *D. linearis* var. *linearis*), *Diplopterygium* dan *Sticherus*, bentuk hampir bulat dalam genus *Gleichenia* manakala bentuk-D hanya dijumpai pada satu species *Dicranopteris* iaitu *D. linearis* var. *linearis*. Dalam berkas vaskular, ciri-ciri seperti taburan lapisan endodermis, rupa bentuk dan perbezaan kelebaran pada bahagian bawah jurang dan lingkaran serta bilangan dan bentuk xilem dan protoxilem juga memainkan peranan penting dalam pengecaman. Variasi pada berkas vaskular batang dalam Gleicheniaceae didapati bererti secara taksonomi di tahap genus dan spesies.

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I certify that an Examination Committee met on 24th August 2006 to conduct the final examination of Chin Lea Yen on her degree of Master of Science thesis entitled “Morphological and Anatomical Variations Among The Genera of Gleicheniaceae” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

CHIN LEA YEN

Date: 27 DECEMBER 2006

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