

## Spore morphological studies on two Drynoid Ferns of Manipur, India

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### Abstract

Critical spore morphological studies were conducted on two drynoids of Manipur viz., *Drynaria quercifolia* (Linnaeus) J. Smith and *Drynaria propinqua* (Wallich ex Mettenius) J. Smith ex Beddome. Sporophytic plants are epiphytic or epilithic and display frond polymorphism with the presence of both fertile and sterile elements. Veins are much anatomising with occasional free included veinlets. Sporangia are globular and dehisced by transverse slit. Scanning Electron Microscopy (SEM) of their spores was carried out in order to evaluate the characters used in the systematic analysis. Perine layer is absent, spores monoletе-bilateral and spinulose. However, considerable differences exist in the nature of ornamentation between the two species. In *D. quercifolia*, spines are acuminate whereas in *D. propinqua*, spines are verrucate.

**Key words:** *Drynaria quercifolia*, *Drynaria propinqua*, Spore morphology, Manipur

### INTRODUCTION

*Drynaria* (Bory) J. Smith, commonly known as oak leaf fern or sometimes basket fern is a genus of Polypodiaceae (Smith *et al.* 2006). It is commonly distributed in the tropical and sub-tropical forests. About twenty (20) species are known from China, Fiji, Indo-Myanmar, Java, tropical Australia, Thailand, and the African and Pacific regions. From India, four species has been recorded so far (Dixit 1984). Two of these, *D. quercifolia* (Linnaeus) J. Smith and *D. propinqua* (Wallich ex Mettenius) J. Smith ex Beddome were reported from Manipur, which are extensively used as ornamentals by different communities (Devi *et al.* 2007). It grows as a branch, trunk or base epiphytes mostly on angiospermic trees like *Phoenix sylvestris* Roxburgh, *Mimusops elengi* Linnaeus, *Mangifera indica* Linnaeus, *Ficus benghalensis* Linnaeus, *Ficus religiosa* Linnaeus, *Tamarindus indica* Linnaeus, *Kigelia pinnata* de Candolle, *Delonix regia* (Hooker) Rafinesque etc. Sometimes, it also grows as epilithophytes on humus deposited walls, rock crevices and mossy stones. The sporophytic body, which forms the dominant phase in the life cycle of ferns is prominent and live longer as compared to the short-living gametophyte. The drynoid ferns show frond polymorphism and reproduces by means of spores. Much importance has been given on spore morphology in these days that serve as a source of systematic unit to circumscribe specificity or to establish hypothetical relationships between or among species within a genus (Bir 1976; Nath & Sharma 2006). Although morphological data on the drynoid ferns of Manipur are available, spore morphology has not been investigated so

far. To establish relevant spore parameters as one of the reliable taxonomic keys in addition to the classical morphology, a spore morphological study was carried out on these two drynoids found in the state of Manipur in North East India.

## METHODOLOGY

Extensive collection of the two species of *Drynaria* was made during the years 2013 – 2015 in the Bishenpur, Chandel, Churachandpur, Imphal East/West, Thoubal, Tamenglong, Senapati and Ukhru Districts of Manipur through repeated field trips round the year. Detailed morphological descriptions of their sporophyte were prepared. For spore-morphology, pieces of fertile fronds with matured but undehisced sporangia were collected from the field in small polythene packets. Size of spores was determined as the average of minimum of 15 readings. It is expressed as polar diameter  $\times$  equatorial diameter. Sporal terminology by Devi (1977) and classification by Smith *et al.* (2006) was followed for the description. Photomicrograph (MIJY–Inverted) and SEM (Model: LEO, 1430VP, Carl Zeiss, at IIT Guwahati) of spores were taken from undamaged and unacetolysed spores. For SEM studies, dried spores were fixed on brass stubs by electron conductive point, kept on the ion sputter and coated with gold vapour (300 Å). For LM studies, dried spores were directly fixed on glycerine and observed for sporal characters. Voucher specimens were deposited in the Manipur University Museum of Plants (MUMP) and compared at CAL and ASSAM. Related notes on ethnobotany, distribution, illustrations and key to species are incorporated.

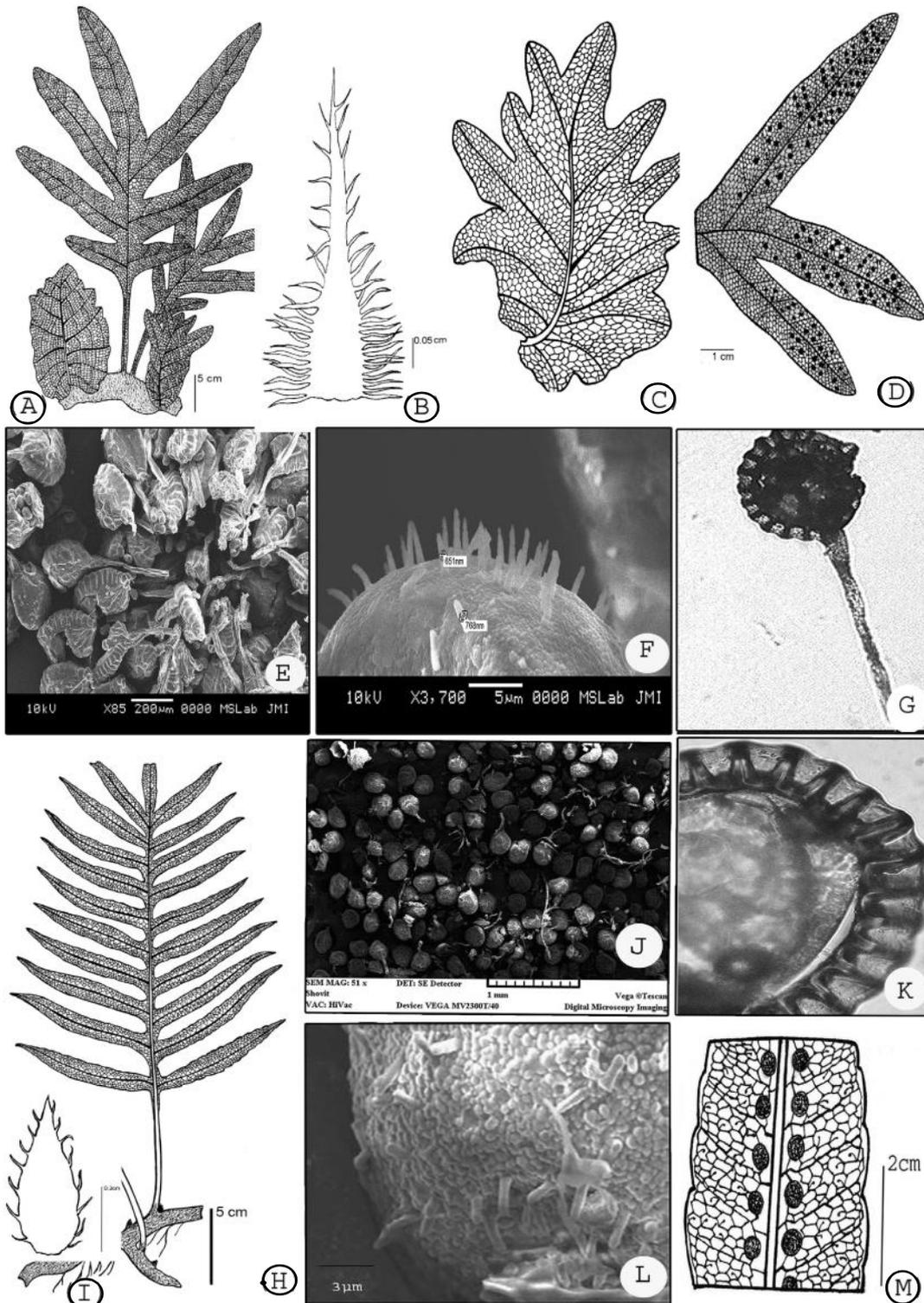
## RESULTS

***Drynaria quercifolia*** (Linnaeus) J. Smith in J. Bot. 3: 398. 1841; Beddome in Handb. Ferns Brit. India 341.t.191. 1883; Clarke in Trans. Linn. Soc. Ser. 2 (Bot.) 1: 555 – 556. 1880. *Polypodium quercifolium* Linnaeus in Sp. Plant. 2: 1753. [**PLATE 1, Figs. A–G**]

Epiphytic or epilithic upto 2000 m amsl. Rhizome creeping, long, fleshy, upto 2 cm thick, densely clothed with scales and roots. Scales 0.8 – 1  $\times$  0.2 cm, linear– lanceolate, dentate-ciliate, hair-tipped, auricled at base, dark brown. Fronds dimorphic: (a) *Sterile fronds* 20 – 30  $\times$  15 – 20 cm, overlaps the base of fertile fronds, rarely distant, erect, sessile, ovate, pinnatifid more or less down to halfway from costa, margin entire; lobes upto 7  $\times$  3 cm, texture coriaceous, both surfaces glabrous, pale–green when young, brownish–grey when dry. Veins and veinlets prominent, raised on both surfaces, forms a close network; (b) *Fertile fronds* 40 – 60  $\times$  15 – 25 cm; stipe upto 20 cm long, greyish–brown, glabrous; lamina deeply pinnatifid nearly reaching the mid–rib, segments upto 18  $\times$  2.5 cm, linear-oblong, entire but slightly wavy when young, acuminate, base decurrent, basal segment narrowly winged on either side of stipe, coriaceous, both surface glabrous, pale green. Veins reticulate, prominently raised, forms a network and interconnected by veinlets. Sporangia 240  $\mu$ m wide and 525  $\mu$ m long, dehiscence by transverse slit. Sori globose, scattered more or less on either side of the main lateral veins of the segments, deep brown, exindusiate, homosporous.

**Sporulation:** October – June

**Spore morphology:** Spores 41  $\times$  55  $\mu$ m, bilateral, monolete, usually plano–convex in lateral view, oblong in polar view, perine absent, spinulose with slender acuminate spines,



**PLATE I: Figs. A – G. *Drynaria quercifolia*:** (A) Habit; (B) Rhizome scale; (C) Sterile frond; (D) Fertile frond; (E) Mature sporangia; (F) Acuminate spines in exine layer; (G) Sporangium with transverse slit (100X). **Figs. H–M: *Drynaria propinqua*:** (H) Habit; (I) Rhizome scale; (J) Sporangia; (K) Annulus of sporangium before dehiscence (400X); (L) Verrucate spines; (M) Fertile pinna showing venation.

irregularly distributed throughout the surface, sometimes more or less aggregated in irregular patches, surfaces in between spines minutely granulose to smooth, deep brown.

**Distribution:** Common in hill ranges of Chandel, Churachandpur, Tamenglong, Ukhrul, Senapati; rarely seen in Imphal East/West, Thoubal, Bishenpur.

**Exsiccatae:** India: Manipur, Thoubal District, Tentha, *Yumkham 002135*, dated 22.10.2013 [MUMP]

*Drynaria propinqua* (Wallich *ex* Mettenius) J. Smith in J. Bot. 4. 61. 1842; Beddome, Ferns Brit. India, t. 160. 1866; Dhir, Ferns N.W. Himalayas, 131.1980; Baishya & Rao, Ferns and Fern-allies Meghalaya, 61. 1982; Jamir & Rao, Ferns Nagaland, 131. 1988. *Polypodium propinquum* Wallich *ex* Mettenius in Abh. Senckneb. Naturf. Ges. 2. 120. t.3. f.50. 1857. [PLATE 1; Figs. H–M]

Epiphytic between 780 and 2000 m amsl. Rhizome creeping, long, fleshy, 0.5 – 1 cm thick, densely clothed with scales. Scales lanceolate, 0.4 – 0.6 × 0.1 cm, acuminate, hair-tipped, margin hairy, reddish-brown. Fronds dimorphic: (a) *Sterile frond*: Distant on rhizome, smaller than fertile frond, 13 – 16 × 9 – 11 cm, obovate to cordate-ovate, deeply pinnatifid, segments lanceolate, 6 – 8 × 1 cm, entire, veins finely reticulate leaving an appearance of net when dry, coriaceous, both surfaces glabrous, pale green when young, glossy; (b) *Fertile frond*: Stipes 10 – 15 × 0.2 – 0.3 cm, glabrous, erect, pale-brown, base densely clothed with scales; lamina 20 – 30 × 10 – 15 cm, deltoid to obovate, deeply pinnatifid nearly reaching the costa, base of lamina decurrent with entire margin on either side as narrow wings at the stipe; segments upto 10 × 1 cm, linear-lanceolate, shallowly crenate, acuminate, coriaceous, green, glabrous on both surfaces; veins prominent, areoles copious with few free veinlets, slightly raised on ventral surfaces. Sporangia 170 µm wide and 640 µm long, dehiscence by transverse slits. Sori globose in a single row on either side of mid-rib, close to costa yellowish-brown when dry, exindusiate, homosporous.

**Sporulation:** May – October

**Spore morphology:** Spores 42 × 63 µm, bilateral, monolete, concavo-convex in lateral view, densely spinulose and verrucate in between with wart-like protuberances, aggregated in irregular dense groups, yellowish-brown.

**Distribution:** The natural population of *Drynaria propinqua* is decreasing at an alarming rate in valley region (Imphal East/West, Thoubal, Bisenpur) due to conversion of forest areas into cultivable land, ruthless destruction of hills and mountains and a host of other anthropogenic activities. It is also evaluated as Rare and Endangered Species of India (Bir 1987). However, it is a common sight in the hilly areas.

**Exsiccatae:** India: Manipur, Ukhrul District, Shirui, *Yumkham 002137*, dated 12.02.2014 [MUMP]

### KEY TO SPECIES

1. Sterile fronds overlap base of fertile fronds, surfaces in between spines of spores minutely granulose to smooth ..... *D. quercifolia*
- 1a. Sterile fronds remain distant from fertile fronds, surfaces in between spines of spores ornamented with verrucate and wart-like protuberances ..... *D. propinqua*

**Ethnobotany and other reported uses:** The *Nagas* and *Kukis* inhabiting the hilly region of Manipur used green or even dried sterile fronds for indoor decorations. Displaying of graceful fronds on the walls during auspicious occasions like weddings, Christmas and other related cultural ceremonies is a common sight in hill villages. Semi-dried sterile fronds are plucked before desiccation and preserved as decoration items. Ornaments, drynoids are also grown on pots and as epiphytes in gardens. Fresh rhizomes are used in treatment of body ache, phthisis, cough, dyspepsia, skin diseases, swellings, bone fracture and typhoid (Jain 1991; Borthakur *et al.* 2001).

### DISCUSSION AND CONCLUSION

The two Drynoids viz, *Drynaria propinqua* and *Drynaria quercifolia* are graceful ferns and extensively used as ornamental plants in Manipur. The two species can be easily differentiated by their sterile fronds and spore characters. It was observed during the study that spore morphology can be used as one of the reliable taxonomic keys for identification. Considerable differences exist in the nature of ornamentation between the two species. In *D. quercifolia*, spines are acuminate whereas in *D. propinqua*, spines are verrucate. With the destruction of natural habitat, population of this two ferns in the valley districts of Manipur have also decreased considerably over the last two decades. Main factors responsible for loss of habitat include clearing of forest for cultivation, burning of forest for fire wood, jhuming and soil erosion. From the above mentioned facts it is worth to be mentioned that the two Drynoids viz, *Drynaria propinqua* and *Drynaria quercifolia* are in the criteria of species to be preserved, because in near future the two species will be species in the category of *Species Extinct in the Wild* due to their utility as they are ornamental plants.

### LITERATURE CITED

- Bir, S.S. 1976. Contribution of spore morphology in the taxonomy of some taxa of ferns. *Adv. Pollen Spore Res.* 2: 92 – 119.
- Bir, S.S. 1987. Pteridophytic Flora of India: Rare and endangered elements and their conservation. *Indian Fern J.* 4: 95 – 101.
- Borthakur, S.K.; Deka, P. & Nath, K.K. 2001. *Illustrated Manual of Ferns of Assam*. Bishen Singh and Mahendra Pal Singh, Dehra Dun, India.
- Devi, S. 1977. *Spores in Indian ferns*. Today & Tomorrow's Printers and Publishers, New Delhi.
- Devi, Y.S.; Devi, K.S. & Singh, P.K. 2007. Floristic study on epiphytic pteridophytes of Thoubal District, Manipur. *Indian J. Env. Eco.* 14(3): 513 – 516.
- Dixit, R.D. 1984. *A Census of Indian Pteridophytes*. Botanical Survey of India, Howrah.
- Jain, S.K. 1991. *Dictionary of Indian Folk Medicines and Ethnobotany*. Deep Publications, New Delhi.
- Nath, V. & Sharma, S. 2006. Scanning electron microscopic studies on spores of some Himalayan mosses. *Phytotaxonomy* 6: 53 – 60.
- Smith, A. R.; Pryer, K. M.; Schuettpelz, E.; Korall, P.; Schneider, H. & Wolf, P.G. 2006. A classification for extant ferns. *Taxon* 55 (3): 705 – 731.