

NEW ADDITIONS OF FERN FLORA TO KOLLI HILLS, EASTERN GHATS, TAMILNADU, INDIA

***S. Sahaya Sathish and P. Vijayakanth**

Centre for Cryptogamic Studies (CCS), Department of Botany, St. Joseph's College (Autonomous),
Tiruchirappalli-620002, Tamil Nadu, India

*Author for Correspondence

ABSTRACT

In the present investigation six new fern species were added to Kolli Hills. The species were *Adiantum latifolium*, *Oleandra musifolia*, *Diplazium cognatum*, *Bolbitis appendiculata*, *Leptochilus thwaitesianus* and *Phymatosorus membranifolium*. *Adiantum latifolium* was the first report in Tamilnadu. The chromosomes were also studied in all the six ferns species. *Adiantum latifolium* has meiotic chromosomes showing $n=30$. It is a diploid cytotype with a sexual form. This is the first report of this species. The morphological characters of all the fern spores were also studied.

Keywords: Kolli Hills, Ferns, New Additions, Chromosome Number

INTRODUCTION

The Kolli Hills is a part of the Eastern Ghats, which is a mountain range that runs almost parallel to the east coast of Tamilnadu. It is located in Namakkal district of Tamil Nadu. It extends to an area of about 418 Km² between 11°10'00"-11°30'00" N latitude and 78°15'00"-78°30'00" E longitude. Its elevation ranges from 700-1000 m (Figure 1). The vegetation is prominently dry deciduous with patches of moist deciduous and semi-evergreen forests. Foot hills have dry deciduous shrub forests. A survey of literature shows that these hills are rich in plant diversity including the lower groups. But there are a limited number of works carried out with the lower group of plants. The pteridophytes include ferns and fern-allies form a largest flora next to the angiosperms in the biodiversity rich Indian subcontinent. They are growing in the moist tropical and temperate forests and their occurrence in different eco-geographically threatened regions from sea level to the highest mountains are of much interest. Pteridophytes are important from the evolutionary point of view, because they show the evolution of vascular system in plants and also clearly show the process of evolution of seed habit in plants. Some species are very beneficial to humans and some of the species attracts many plant lovers for their graceful, fascinating and beautiful foliage. Ecologically they adapt to almost all possible situations from tropic to temperate region except in the Polar Regions and deserts (Rajesh, 2013). More than 12,000 species of Pteridophytes are estimated and distributed along different bio-geographical regions of India (Dixit, 1984; Chandra, 2000). Most of the pteridophytes diversity in India is observed in the Himalayas, Eastern and Western Ghats (Dixit, 2000). In the present study six ferns species were added newly to Kolli hills. Their cytology and spore morphology were also studied.

MATERIALS AND METHODS

Taxonomic surveys and field visits were made from July 2014 to April 2016 throughout the Kolli Hills of Eastern Ghats, Tamilnadu. The collected specimens were identified with the help of literatures and floras like Beddome (1892), Manickam (1986), Manickam and Irudayaraj (1992). The herbarium was prepared for the species identified. The young fertile fronds were collected in the early morning and fixed in Carnoy's fluid. The meiotic chromosome studies were carried out by the acetocarmine squash technique (Manton, 1950). The fern spores were collected from living plants growing in the field. Spores were washed with 95% alcohol and mounted in glycerin and observed in light microscope to study the spore morphology such as size, shape, colour and surface, (Erdtman, 1952, 1957). The size of the spores was measured by calculating mean averages of a minimum of 10 readings of each sample for the length of the Polar axis (P) × Equatorial axis (E) (Devi, 1977). The specimens were made in to Herbarium and

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deposited in the Centre for Cryptogamic Studies (CCS), Department of Botany, St. Joseph’s College (Autonomous), Tiruchirappalli-620002, Tamilnadu, India.

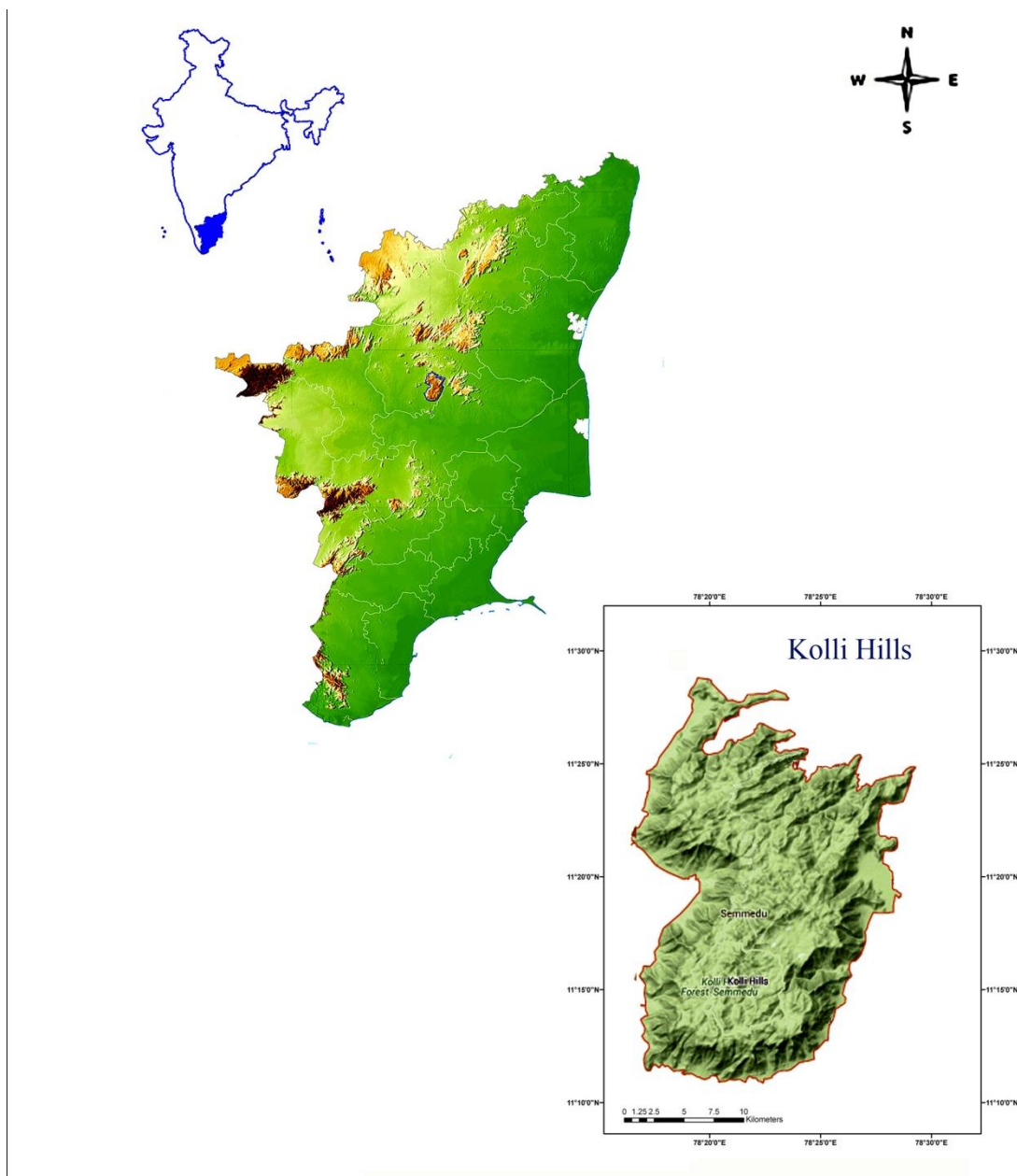


Figure 1: Located Map of the Study Area

RESULTS AND DISCUSSION

Among the 350 samples collected, 66 species of fern flora under 44 genera of 22 families were identified. Of these six fern species were reported from the study area of Kollī Hills. The species were *Adiantum latifolium*, *Oleandra musifolia*, *Diplazium cognatum*, *Bolbitis appendiculata*, *Leptochilus thwaitesianus* and *Phymatosorus membranifolium*. The chromosomal number and spore morphological characters of all the fern species were also studied.

Pteridaceae

Adiantum Latifolium: Lam., Enc. 1: 43 (1783); C.C., Ind. Fil. (rept.) 28 (1906) (Figure a).

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Rhizome creeping, densely covered scales, ovate-lanceolate or lanceolate, about 1.5 mm, evenly pale brown, acuminate apex, margin fimbriate. Stipe arranged alternate rows, abaxially rounded, adaxially grooved, black, stiff, glossy, glabrous below, above pubescent. Lamina broadly ovate, bipinnate, apex acute, base cuneate, alternate, distinctly stalked, largest pinna up to 5×2.8cm, oblong-lanceolate, acute, shortly stalked, largest pinnule 3.8×1.7cm, oblong, straight or slightly falcate, one third of the lower base excised, upper base truncate, apex acuminate, rarely rounded, veins slightly distinct above and below, forked, reaching the margin, pinna green, glabrous above and below, long narrow, pale brown hairs, scales densely covered by costa and rachis, texture herbaceous. Sori oblong or reniform, upper margin, dark brown, thin, fimbriate indidium, sporangia and spores abortive, Spore 28×40 μ , trilete, tetrahedral, brown, perforate or granulose.

Cytology: Cytological preparation showed n=30 meiotic chromosomes (Figure c). It is a diploid and sexual form. This is first report of this species. Mathew (1965) & Walker (1985) have reported a tetraploid form of this species with n=60 chromosomes from Kerala. Walker (1973) has reported mitotic chromosomes (2n=120) in root tip of this species from Jamaica.

Specimen Examined: *Adiantum latifolium*, Semmedu, Kolli Hills. CCS-324, 10.4.2016

Habit: Terrestrial herb.

Habitat: Shaded place of forest, 1350m.

Status: Common.

Distribution: Kerala, India, Sri Lanka and tropical America.

Sources: Madhusoodanan & Sevichan (1991), Manickam & Irudayaraj (1992), Kumar (1998) and Easa (2003).

Economic Importance: Used in Latin American traditional medicine as antidiuretic, analgesic and anti-inflammation (Fambiana *et al.*, 2001)

Notes: This species was found solely from Semmedu, Kolli Hills. There is no report of this species in Tamilnadu so far. Dixit (1984) has not reported this species in the flora *Census Indian Pteridophytes*.

Oleandraceae

Oleandra Musifolia: (Blume) C. Presl., Epim., Bot. 42 (1849) (Figure d).

Rhizome long creeping, branched, wiry, strong root, all over covered by scales, imbricate, lanceolate, up to 8mm, polished, brown, apex acuminate, base cuneate, entire margin, Fronds simple, borne in pairs opposite to rhizome branch, stipe articulate, about 15mm, polished, covered by similar rhizome scales. Lamina about 40×3cm, oblong-lanceolate, slightly falcate, progressively narrowing, apex acuminate, cuneate base, entire margin, midrib distinctly raised below and above, grooved above, veins distinct above and below, forked, veinlets parallel, free, reaching the margin, frond yellowish green, glossy, texture chartaceous. Sori in two flexuous rows along the midrib, reniform, indusia dark brown, entire, spore 37 × 45 μ , reniform, monoletic, elliptic, brown, medium, granulose with fold or anastomosed perispore.

Cytology: The chromosome number of this species were found to be n=40 (Figure e). It is diploid cytotype with 64 normal spores which found in the sporangia as sexual form. The cytotype was previously reported by Abraham *et al.*, (1962). Ammal & Bhavanandan (1991) have reported tetraploid cytotype (n=82) from South India.

Specimen Examined: *Oleandra musifolia*, Kuzhivalau, Kolli Hills. CCS-331, 10.4.2016

Habit: Epiphytic herb.

Habitat: Interior area of evergreen forest, high humidity, 1400m.

Status: Common.

Distribution: Anamalais Hills, Tirunelveli, Palni Hills, Pamba Hills, Nilgiris. Kerala, India, Sri Lanka, Northern Queensland, China, Myanmar, Thailand, Japan, Taiwan, Malaysia, Vietnam.

Sources: Manickam (1984), Manickam & Irudayaraj (1992), Nayar & Geevarghese (1993), Nair *et al.*, (1994) & Hameed (2000).

Economic Importance: Stipes was preferred to decoction to consider being an emmenagogue. These fern rhizomes are used in snake bite in Philippines (Dixit & Vohra, 1984).

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Notes: This species is collected in Kuzhivalau. It is rare species because this species found in the single location of Kolli Hills.

Athyriaceae

Diplazium Cognatum: (Hieron.) Sledge, Bull. Br. Mus. Nat. Hist. Bot. 2(2): 308 (1962) (Figure g).

Rhizomes short creeping or Sub erect, densely covered scales, lanceolate, up to 8mm, dark brown, apex acuminate, margin entire. Stipe compact, up to 29.5cm, abaxially rounded, adaxially grooved, pale brown stramineous, sparsely scaly below, glabrous above. Lamina ovate to deltoid, up to 40×19cm, slender, apex acute, cuneate base, tripinnate below, bipinnate above, sub-opposite or alternate, oblong-lanceolate, up to 12×3.5cm, shortly stalk, apex acuminate, cuneate base, margin pinnatifid, slightly falcate, apex rounded, base decurrent, margin serrate or shallowly lobed, costa flattened, above and below, veins pinnate, forked, free, green, glabrous all over, texture herbaceous. Sori linear along with veins, up to seven pairs per lobe, Spores 35×51µ, monolete, ellipsoidal shape, reniform, brown, smooth exine.

Cytology: The chromosomes count were showing n=41 in spore mother cells (Figure h). It is diploid sexual nature. The same results were recorded for this species by Manickam & Irudayaraj (1988).

Specimen Examined: *Diplazium cognatum*, Periya sholai, Kolli Hills. CCS-353, 10.4.2016

Habit: Lithophyte herb.

Habitat: Stream banks and fully shaded places. 1350m.

Status: Common.

Distribution: Anamalais, Palni Hills, Nilgiris. Kerala, India, Sri Lanka and Tropical America, Thailand, Malaysia, China and Vietnam

Sources: Madhusoodanan & Sevichan (1991), Manickam & Irudayaraj (1992), Kumar (1998) and Easa (2003).

Notes: This species was found in stream bank and rock. This is a rare species collected from Semmedu area only.

Dryopteridaceae

Bolbitis Appendiculata: (Willd.) K. Iwatz. In Acta Phytotax. Geobot. 18: 48 (1959) (Figure j).

Rhizome short creeping covered by scales, ovate-lanceolate, pale brown, apex acuminate, fimbriate margin, base sinuate. Stipe in two rows closely arranged, alternate, up to 30cm, dark green, dryly grey green, adaxially grooved, abaxially rounded. Sterile lamina lanceolate, up to 25×10cm, simply pinnate, wide, acuminate apex, base truncate, rooting for small vegetative bud grow in apex, pinnae up to 21 pairs, opposite below, sub opposite or alternate above, subsessile or sessile, largest pinna 7.5×1.2cm, apex acute or acuminate, cuneate base, margin crenate or shallowly lobed, costa slightly raised, veins obscure, forked, free, reaching margin, pinna dark green, texture firm herbaceous. Small toothed scale covered by all over the rachis of sterile and fertile fronds. Fertile stipe up to 38cm, scale lanceolate, up to 2mm, apex acuminate, margin fimbriate, pale brown, fertile pinnae up to 17 pairs, oblong, up to 2×0.5cm, apex rounded, base sub-truncate, margin crenate. Sori acrostichoid, covering the lower side, covering the costa, spore monolete, 60×69µ, spherical shape, brown color, anastomosed surface, folded, perispore winked.

Cytology: The diploid sexual chromosomes were observed which is showing 41 in spore mother cells (Figure k). The same results were recorded for this species by Abraham *et al.*, (1962), Bhavanandan (1981), Manickam (1984), Irudayaraj & Manickam (1987) & Manickam & Irudayaraj (1988).

Specimen Examined: *Bolbitis appendiculata*, Semmedu, Kolli Hills. CCSH-353, 10.4.2016.

Habit: Lithophyte herb.

Habitat: Large colonies in fully shaded running water of streams. 1350m.

Status: Least concern.

Distribution: Kothayar, Agastiar Hills, Anamalais, Palni Hills, Nilgiris. Kerala, India, Sri Lanka and Tropical America, Thailand, Malaysia, China and Vietnam

Sources: Madhusoodanan & Sevichan (1991), Manickam & Irudayaraj (1992), Kumar (1998) and Easa (2003).

Notes: According to IUCN 2003, this species is considered as the least concern of India (Kumar, 2013). This species was found in stream bank and rock. This is a rare species collected from Semmedu area only.

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Polypodiaceae

Leptochilus Thwaitesianus: Fee, Mem. Fam. Foug. 10: 7, Pl. 24(1865) (Figure m).

Rhizomes creeping, green, dark brown when dry, covered by scale all over, ovate-lanceolate, about 3mm, brown, apex acuminate, margin entire. Frond dimorphic. Fertile frond: Stipe scattered up to 41cm, fertile laminae, up to 15cm, green, abaxially rounded, shallowly grooved adaxially, glabrous all over. Sterile frond: Stipe scattered up to 25cm, Sterile laminae lanceolate, up to 27.5cm, widest at the sub-basal region, rounded apex; abruptly decurrent base, margin entire, wavy, midrib raised distinctly below, slightly above, rounded below, flatted above, veins distinct, copiously, irregularly anastomosing, dark green, glabrous, sub-coriaceous texture. Fertile fronds oblong, entire margin, cuneate base, sori acrostichoid, distributed all over the lower surface, up to 1cm wide. Spore $43 \times 55 \mu$, monolete, ellipsoidal, yellowish brown, perforate with chlorophyll.

Cytology: A total number of 72 chromosomes were observed in this species which was collected from Periya sholai (Figure n). This is tetraploid cytotype with sexual reproduction. 64 spores were found in the single sporangia. This is first report of this species.

Specimen Examined: *Leptochilus thwaitesianus*, Periya Sholai, Kolli Hills. CCS-357, 04.05.2016

Habit: Lithophytic herb.

Habitat: Stream bank of forest, 1300m.

Status: Common.

Distribution: Palni Hills, Anamalais, Devikulam, Prasnath hills, Kerala, India. China, Indonesia, Malaysia, Sri Lanka, Thailand, Vietnam, Philippines.

Sources: Satija & Bir (1985), Manickam & Irudayaraj (1992), Nampy & Madhusoodanan (1998) & Easa (2003).

Notes: This species commonly distributed in Periyar sholai of Kolli Hills. It is rare species of Sri Lanka (Sledge, 1956) and Western Ghats (Manickam & Irudayaraj, 1992).

Phymatosorus Membranifolium: (R.Br) S.G.Lu Guihaia 19(1): 27–28 (1999) (Figure p).

Rhizome short creeping, terete, up to 3mm, green and fleshy when fresh, loosely covered scales, ovate or deltoid, dark brown, apex acute, margin with few minute outgrowths. Stipe scattered, up to 18cm, more or less terete or shallowly grooved above, brown, glabrous and glossy. Lamina up to 25cm, ovate, apex acute, base cuneate, pinnae up 6 pairs, alternate, oblong-lanceolate, up to 13.5cm, 1.5cm wide, abruptly decurrent on the basiscopic base, entire margin, costa distinct raised below, slightly raised above, rounded above and below, veins distinct, freshly pinnae green, dried pinnae brown, glabrous, texture herbaceous. Sori in one row on either side of midrib, sub-median, extruded above by raised cavity. Spore $30 \times 44 \mu$, monolete, ellipsoidal shape, bilateral, yellow, exine smooth.

Cytology: The meiotic chromosomes count were showing $n=36$ (Figure q). It is diploid sexual form. Manickam & Irudayaraj (1988) have given the same report from South India. 72 chromosome numbers were reported by Ammal & Bhavanandan (1991) and Abraham *et al.*, (1962). Kato (1999) has recorded 72 chromosomes from South China.

Specimen Examined: *Phymatosorus membranifolium*, Semmedu, Kolli Hills. CCS-357, 10.4.2016

Habit: Lithophytic herb.

Habitat: Shaded place of forest, 1300m.

Status: Common.

Distribution: Palni Hills, Anamalais. Kerala, India. China, Indonesia, Malaysia, Sri Lanka, Thailand, Vietnam, Philippines.

Sources: Satija & Bir (1985), Manickam & Irudayaraj (1992) & Nampy & Madhusoodanan (1998).

Economic Importance: In Borneo it is eaten (Manickam & Irudayaraj, 1988).

Notes: This species rarely distributed and single collection of Kolli Hills. The plant is often grown as an ornamental. No record from Tirunelveli and Palni Hills.

Manickam & Irudayaraj (1992) have reported 256 pteridophytes from Western Ghats, South India. They also reported some of the species from Kolli Hills. Dominic (1996) has studied intra specific variation of ten species and also reported 71 species, 49 genera from Kolli Hills. He also recorded different altitude

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ranges, vegetation types and soil humidity from this area. Perumal (2010) has reported ten ethno-medicinally important ferns and fern allies. Karthik *et al.*, (2011) have also collected 30 ethnomedicinal important ferns. Revathi *et al.*, (2013) have listed 50 medicinally useful ferns and fern-allies species. Recently, Gowrisankar *et al.*, (2011) have surveyed habitat and distribution patterns of 80 fern and fern-allies species.

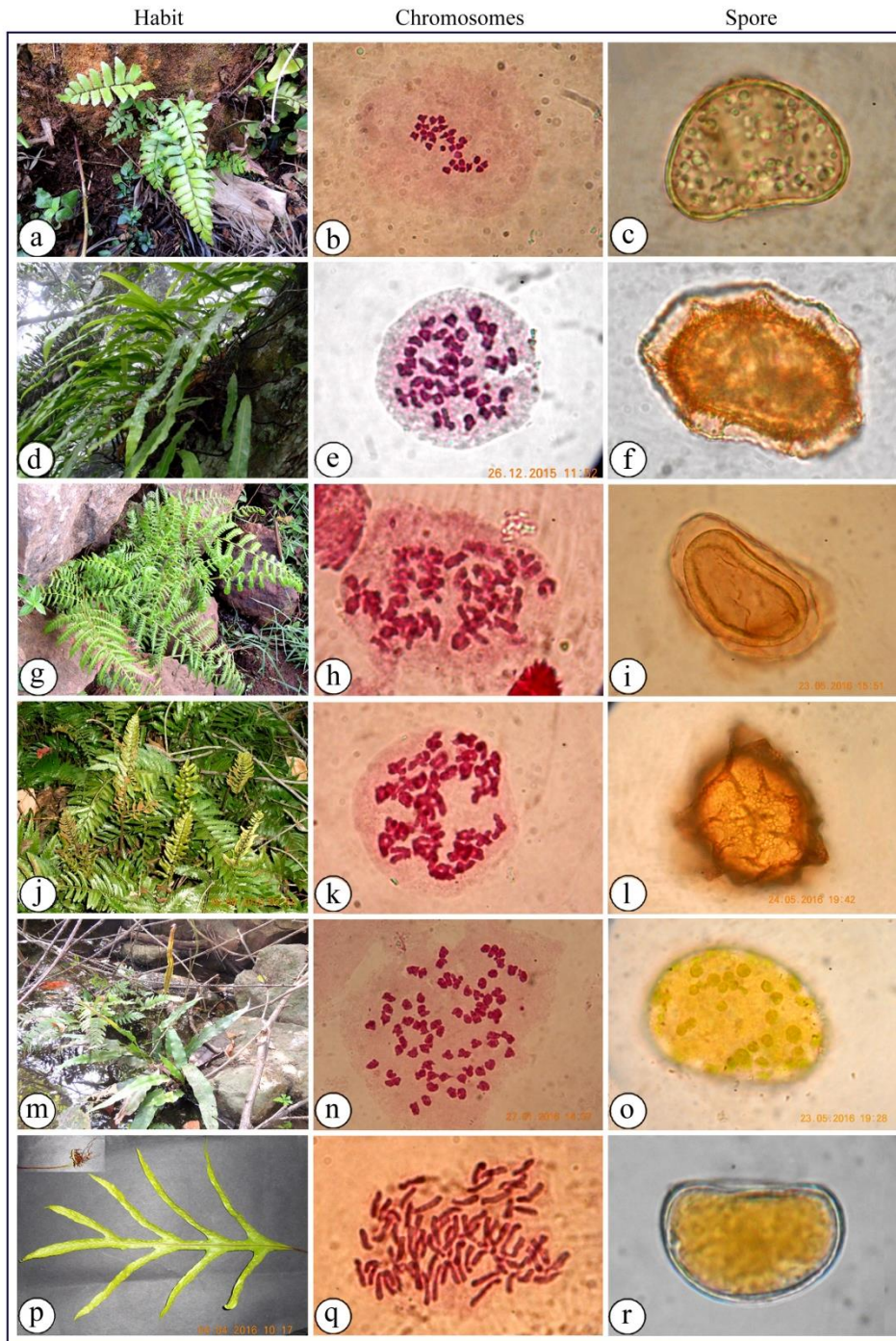


Figure-2. a-c. *Adiantum latifolium*, d-f. *Oleandra musifolia*, g-i. *Diplazium cognatum*, j-l. *Bolbitis appendiculatum*, m-o. *Leptochilus thwaitesianus*, p-r. *Phymatosorus mebranifolium*.

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Summary and Conclusion

In the present study six species such as *Adiantum latifolium*, *Oleandra musifolia*, *Diplazium cognatum*, *Bolbitis appendiculata*, *Leptochilus thwaitesianus* and *Phymatosorus membranifolium* were recorded for the first time in Kolli Hills, Eastern Ghats, Tamil Nadu. It is new addition of fern flora of Kolli Hills. *Adiantum latifolium* species was new report of Tamilnadu. Dixit (1984) has no report of this species in the flora *Census Indian Pteridophytes*. Manickam & Irudayaraj (1992) have collected in Western Ghats of Kerala.

Cytological studies of these five species were diploid and one species were tetraploid cytotypes. It is a sexual form. One is new chromosome report of *Adiantum latifolium*, *Leptochilus thwaitesianus* and remaining species were same results to conform for earlier chromosomes reports from various regions of India. The cumulative cytological data indicate that ploidal evolution is a dynamic aspect of fern evolution. Furthermore ploidy and mode of reproduction are often involved in bio-geographic relationships in ferns (Bir & Verma, 2010).

Morphological characters were also described for all the fern species. The six fern spores are divided in to two types such as monolete (five species) and trilete (one species). Largest spore size is found in *Bolbitis appendiculata* (60×69µ). Most of the spore surface patterns were granulose in three species remaining species were psilate and tuberculate. *Leptochilus thwaitesianus* spores were granulose with chlorophyll. The colours of the spore colours were commonly brown and yellow. The spore characters are considered together with morphological features of the sporophytes.

They become useful complementary tools that could lead to the establishment of more natural group in the genus. Spore morphology would be very useful in solving the pending problem of taxonomy, phylogeny and phytogeography.

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