Cytological Observations on Some South Indian Ferns

P. I. Kuriachan

Department of Botany, Kerala University, Trivandrum, India

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An extensive survey of the Pteridophyte flora of South India was started a few years back in the Department of Botany, Kerala University, Trivandrum and the cytological data relating to more than 150 species of South Indian Pteridophytes were reported earlier (Abraham and Ninan 1954, 1958, 1965, Abraham *et al.* 1962, Ninan 1955, 1956 a-e, 1958 a-c, Kuriachan 1963, 1965). It has been possible to investigate the cytology of 40 more taxa belonging to 32 species of leptosporangiate ferns and the important observations are presented here. Details regarding the various species will be reported elsewhere.

Materials and methods

Most of the species investigated during the present study were collected from hill stations in South India such as Aryankavu (600 M), Courtallum (650 M), Ponmudi (500–1050 M), Munnar (1500 M), Ootacamud (1500–2100M) and Kodaikanal (1800–2000 M). Some of the species were also collected from the plains of Kerala. A few garden materials of unknown wild origin were also studied. In making cytological preparations the usual acetocarmine squash and smear techniques were followed (Abraham *et al.* 1962).

Observations

Both meiotic and mitotic chromosomes were examined in most of the species studied. In a few cases, due to lack of suitable materials, either the meiotic or the somatic number alone could be studied. Details regarding the chromosome numbers in the materials investigated are given in Table 1.

Table 1. Chromosome numbers in some South Indian ferns

Species	Source	Chromosome number		Ploidy
		n	2n	
<i>Trichomanes intramarginale</i> Hook & Grev.	Ponmudi hills	36	72	tetraploid
<i>T. plicatum</i> Bedd.	"	36	—	"
<i>Dennstaedtia glabrescens</i> Ching	Trivandrum Public Gardens	—	182	"
<i>Microlepia platyphylla</i> (Don.) J. Sm.	Perumal malai- Kodaikanal	43	86	diploid
<i>Lindsaya cultrata</i> Sw.	Bear Shola- Kodaikanal	ca. 153	—	hexaploid
<i>L. heterophylla</i> Dryander	Ponmudi hills	86	—	tetraploid
<i>Pteridium aquilinum</i> var. <i>wightianum</i> (Wall.) Tryon	"	52	104	diploid
<i>Idiopteris hookeriana</i> (Agardh) T.G. Walker	Kodaikanal	—	108	tetraploid

<i>Pteris ensiformis</i> var. <i>victoriae</i>	Trivandrum Public Gardens	irregular meiosis	87	triploid
<i>P. ensiformis</i> var. <i>victoriae</i>	"	"	84	ca. triploid
<i>P. ensiformis</i> var. <i>victoriae</i>	"	84	168	ca. hexaploid
<i>P. multiaurita</i> Agardh	Ponmudi hills	29	58	diploid
<i>P. pellucida</i> Presl.	Muvattupuzha, Parambikulam	58	116	tetraploid
<i>P. pellucida</i> Presl.	Aryankavu	29	58	diploid
<i>P. ottaria</i> Bedd.	Ponmudi hills	29	58	diploid
<i>Pellaea boivini</i> Hook	"	30	60	diploid
<i>Adiantum macrophyllum</i> Sw.	Trivandrum Public Gardens	30	60	diploid
<i>A. capillus veneris</i> L. cv.	"	30	60	diploid
<i>A. polyphyllum</i> Willd	"	sterile	120	tetraploid
<i>Ceratopteris thalictroides</i> (L.) Brongn.	Parambikulam	38	—	ca. diploid
<i>C. thalictroides</i> (L.) Brongn.	Nilambore	76	—	ca. tetraploid
<i>C. thalictroides</i> (L.) Brongn.	Veli-Trivandrum.	80	—	tetraploid
<i>Nephrolepis multiflora</i> (Roxb.) Jarret	The kady	82	164	"
<i>N. multiflora</i> (Roxb.) Jarrett	Lal Bagh Gardens-Bangalore	—	82	diploid
<i>Doodia media</i> R. Br.	Kodaikanal	60	120	tetraploid
<i>Asplenium crinicaule</i> Hance	Ponmudi hills	144	—	octoploid
<i>A. erectum</i> Bory	Bear shola-Kodaikanal	36	—	diploid
<i>A. formosum</i> Willd	Bear shola - Kodaikanal, Courtallum, Palaruvi - Aryankavu, Ponmudi hills	36	—	diploid
<i>A. indicum</i> Sledge	Bear shola and Fairy falls-Kodaikanal, Ponmudi hills	144	—	octoploid
<i>A. normale</i> Don.	Pillar rocks - Kodaikanal	36	—	diploid
<i>A. unilaterale</i> Lam.	Munnar	76	ca. 152	tetraploid
<i>A. unilaterale</i> Lam. v. <i>rivale</i> Bedd.	Pillar rocks - Kodaikanal	40	—	diploid
<i>Microsorium membranaceum</i> (Don.) Ching	Kodaikanal	36	72	diploid
<i>M. pteropus</i> (Bl.) Ching	Ponmudi hills	36	72	diploid
<i>M. pteropus</i> (Bl.) Ching	Ootacamund	irregular meiosis	108	triploid
<i>Colysis elliptica</i> (Thbg.) Ching	Lal Bagh Gardens-Bangalore	36	72	diploid
<i>Grammitis attenuata</i> Kze.	Ponmudi hills	36	72	diploid
<i>Loxogramme involuta</i> Presl.	Bear shola - Kodaikanal	70	—	tetraploid
<i>Vittaria elongata</i> Sw.	Muvattupuzha, Palode-Trivandrum	120	240	octoploid
<i>Salvinia auriculata</i> Aubl.	Veli-Trivandrum	irregular meiosis	45	pentaploid

Discussion

During the present investigation the cytology of 40 taxa belonging to 32 species of South Indian ferns has been studied. This includes cytological informa-

Figs. 1-10. $\times 750.1$, diakinesis in a spore mother cell of *Grammitis attenuata* showing 36 bivalents. mitotic metaphase in a root tip cell of *Doodia media* showing 120 chromosomes. 3, diakinesis in a spore mother cell of *D. media* showing 60 bivalents. 4-6, mitotic metaphase in root tip cells

tion on 11 species, on which there is no previous report and new chromosome counts on 13 taxa, for which other numbers have been reported from various geographic regions.

Data on chromosome numbers given in Table 1 show the existence of additional basic chromosome numbers in the genera *Lindsaya*, *Pellaea*, *Ceratopteris*, *Doodia* and *Grammitis*. Earlier reports of chromosome numbers show $n=29$, 58, 87, ca. 90 and 116 in *Pellaea*, $n=40$, 76, 77, 78 and 80 in *Ceratopteris* and $n=37$ in *Grammitis* (see Chiarugi 1960 and Fabbri 1963, 1965). The present investigation has revealed the existence of the haploid numbers $n=30$ in *Pellaea boivini*, $n=38$ in *Ceratopteris thalictroides* (Fig. 11) and $n=36$ in *Grammitis attenuata* (Fig. 1) which are new counts for the above genera. Previous reports (see Chiarugi 1960 and Fabbri 1963, 1965) indicate the presence of chromosome numbers like $n=34$, 82, 47, 150 and 155 in *Lindsaya*. Based on these numbers, Fabbri (1965) has suggested 34, 41(?), 47, and ca. 50 as possible basic numbers in this genus. The present finding of $n=86$ in *Lindsaya heterophylla* which is the first report in this species suggests the possibility of yet another basic number ($x=43$) for the genus. Brownlie (1961) has reported $n=64$ in *Doodia media*. The present finding of $n=60$ and $2n=120$ (Figs. 3 and 2) in *Doodia media* indicates the possibility of a new basic number ($x=30$) for the genus.

The occurrence of more than one cytotype has been encountered in *Pteris ensiformis* var. *victoriae*, *P. pellucida*, *Asplenium unilaterale*, *Ceratopteris thalictroides* and *Microsorium pteropus*. Different clones of *Pteris ensiformis* var. *victoriae* investigated during the present study showed somatic chromosome numbers like $2n=87$ (Fig. 4), $2n=84$ (Fig. 5) and $2n=168$ (Fig. 6). Materials of *Pteris pellucida* collected from Aryankavu were diploids with $n=29$ and $2n=58$ (Figs. 7 and 8). Two other collections of the same species obtained from Parambikulam and Muvattupuzha were tetraploids with $n=58$ and $2n=116$ (Fig. 9). *Asplenium unilaterale* showed two cytotypes with $n=40$ and $n=76$ (Fig. 10) respectively. Chromosome numbers like $n=38$ (Fig. 11), $n=76$ and $n=80$ (Fig. 12) were met with in materials of *Ceratopteris thalictroides* collected from different places. Two distinct cytotypes, a diploid with $n=36$ and $2n=72$ (Fig. 13) and a triploid with $2n=108$ (Fig. 14) of *Microsorium pteropus* were also investigated.

Irregular meiotic behaviour suggesting possible hybrid origin has been observed in *Pteris ensiformis*, *Microsorium pteropus* and *Salvinia auriculata* with $2n=45$ (Figs. 15 and 16). *Adiantum polyphyllum* was found to show complete sterility and in all likelihood is of hybrid origin. While these species are incapable of sexual

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of *Pteris ensiformis* var. *victoriae*. 4, $2n=87$ (Trivandrum Public Gardens). 5, $2n=84$ (Trivandrum Public Gardens). 6, $2n=168$ (Trivandrum Public Gardens). 7-9, meiotic and mitotic chromosomes in *Pteris pellucida*. 7, metaphase I in a spore mother cell showing 29 bivalents (Aryankavu). 8, mitotic metaphase 7, in a root tip cell showing 58 chromosomes (Aryankavu). 9, mitotic metaphase in a root tip cell showing 116 chromosomes (Muvattupuzha). 10, metaphase I in a spore mother cell of *Asplenium unilaterale* showing 76 bivalents.

Figs. 11-16. $\times 750$. 11-12, diakinesis in spore mother cells of *Ceratopteris thalictroides*. 11, $n=38$ (Parambikulam). 12, $n=80$ (Veli). 13-14, mitotic metaphase in root tip cells of *Microsorium pteropus*. 13, $2n=72$ (Ponmudi hills). 14, $2n=108$ (Oottacamund). 15-16, meiotic and mitotic chromosomes in *Salvinia auriculata*. 15, irregular meiosis in a spore mother cell. 16, mitotic metaphase showing 45 chromosomes.

reproduction, they propagate vegetatively through rhizomes. This may provide an explanation for the occurrence of a good number of natural hybrids among present day ferns.

Summary

Cytological observations on 40 taxa of South Indian ferns belonging to 32 species were made. Eighteen of these are diploids and the others show various levels of polyploidy (triploid to octoploid).

Haploid chromosome numbers like $n=30$, $n=38$, and $n=36$ were observed in *Pellaea boivini*, *Ceratopteris thalictroides* and *Grammitis attenuata* respectively, which are new reports for these three genera. Evidences of new basic numbers like $x=43$ and $x=30$ were also obtained in the genera *Lindsaya* (*L. heterophylla*, $n=86$) and *Doodia* (*D. media*, $n=60$, $2n=120$) respectively.

The occurrence of more than one cytotype has been demonstrated in *Pteris ensiformis* v. *victoriae*, *P. pellucida*, *Ceratopteris thalictroides*, *Asplenium unilaterale* and *Microsorium pteropus*.

Irregular meiotic behaviour suggestive of hybrid origin has been studied in *Pteris ensiformis*, *Microsorium pteropus* and *Salvinia auriculata*. *Adiantum polyphyllum* was found to be a sterile hybrid.

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References

- Abraham, A. and Ninan, C.A. 1954. Chromosomes of *Ophioglossum reticulatum* L. Curr. Sci. **23**: 213-14.
- and — 1958. Cytology of *Isoetes*. Ibid. **27**: 60-61.
- and — 1965. Morphological and cytological notes on *Psilotum nudum* (L.) Beauv. Caryologia **18**: 537-539.
- Abraham, A., et al. 1962. Studies on the cytology and phylogeny of the Pteridophytes: VII. Observations on one hundred species of South Indian Ferns. Jour. Indian Bot. Soc. **41**: 339-421.
- Brownlie, G. 1961. Additional chromosome numbers in New Zealand Ferns. Trans. Roy. Soc. New Zealand, Bot., **1**: 1-4.
- Chiarugi, A. 1960. Tavole cromosomiche delle Pteridophyta. Caryologia **13**: 27-150.
- Fabbri, F. 1963. Primo supplemento alle "Tavole cromosomiche delle Pteridophyta" di Alberto Chiarugi. Caryologia **16**: 237-335.
- 1965. Secondo supplemento alle "Tavole cromosomiche delle Pteridophyta" di Alberto Chiarugi. Caryologia **18**: 675-731.
- Kuriachan, P.I. 1963. Cytology of the genus *Selaginella*. Caryologia **28**: 376-380.
- 1965. Cytology of *Lycopodium cernuum* L. Caryologia **18**: 633-636.
- Ninan, C.A. 1955. Cytology of *Equisetum debile*. Jour. Indian Bot. Soc. **34**: 112-114.
- 1956a. Cytology of the Ophioglossaceae. Curr. Sci. **25**: 161-162.
- 1956b. Studies on the cytology and phylogeny of the Pteridophytes. I. Observations on the Marattiaceae. Jour. Indian Bot. Soc. **35**: 233-239.
- 1956c. Cytology of *Psilotum nudum* L. Cellule **57**: 307-318.
- 1956d. Studies on the cytology and phylogeny of Pteridophytes. III. Observations on *Osmunda regalis* L. Jour. Indian Bot. Soc. **35**: 248-251.
- 1956e. Studies on the cytology and phylogeny of Pteridophytes. IV. Systematic position of *Ceratopteris thalictroides* (L.) Brongn. Ibid. **35**: 252-56.

- 1958a. Studies on the cytology and phylogeny of the Pteridophytes. V. Observations on the Isoetaceae. *Ibid.* **37**: 93–103.
  - 1958b. Studies on the cytology and phylogeny of the Pteridophytes. II. Observations on the genus *Lycopodium*. *Proc. Nat. Inst. Sci. India* **24** B: 54–66.
  - 1958c. Studies on the cytology and phylogeny of Pteridophytes. VI. Observations on the Ophioglossaceae. *Cytologia* **23**: 291–316.
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