Journal of Biosphere, 1: 1-3, 2012 ISSN 2278 – 3342

Studies on two apogamous ferns of Kashmir, J&K, India

Bharti Razdan

Abstract: Apogamous fern species produce normal fertile 32 spores per sporangium. Prothalli produced by germination of the spores may or may not have anthredia, but archegonia if present are non functional. Prothalial tissue gives rise to sporophyte without fertilization. Studies on apomictic diploid *Pteris cretica* (n=2n=58) and triploid *Dryopteris odontoloma* (n=2n=123) were carried out. *Pteris cretica* is a hybrid between two related species while as *Dryopteris odontoloma* is comprised of two genomes possessing close homology.

Key words: Apogamy; cytology; morphology; scales, spores.

1. Introduction

Formation of 64 spores per sporangium is a rule in homosporous ferns but the species which undergo the phenomenon of apogamy produce only 32 instead of 64 spores per sporangium. The spores produced by these apogamous species are normal and fertile. On germination these spores produce prothalli which are devoid of archegonia, anthredia may or may not be present. So no sexual fusion takes place in these taxa and sporophyte is formed directly from central tissue of the prothallus. The first leaf of this type of sporophyte is more adult like than that of sexually produced sporophyte (Manton, 1950) Apogamy is completely lacking in primitive ferns and fern allies (Mehra, 1961). Apogamous reproduction in ferns is strongly associated with ploidy level (Huang et al, 2011). More than 75% apogamous ferns are polyploid (Walker, 1962, Kanamori, 1972, Park and Kato, 2003). Opportunities for apogamy increase with the addition of chromosomes (Heilbrom, 1932). Fern genera in which the phenomenon of apomixes is mostly reported are *Pteris* L., *Dryopteris* Adns., *Pellaea* Link., *Adiantum* L. *and Diplazium* Swartz. Presently detailed studies on apomictic diploid *Pteris cretica* L. and triploid *Dryopteris odontoloma* (Moore) C. Chr. are recorded.

2. Materials and Method

Morphological description is based on the plants of *Pteris cretica* collected fom Dachigam at an altitude of 1,700m and that of *Dryopteris odontoloma* collected from Emporium garden at an altitude of 1,600m. Scales and spores of both the species were mounted in Hoyer's medium (Anderson, 1954). Meiotic studies are based on usual acetocamine squash preparations of developing sporangia. For somatic chromosome counts in *D. odontoloma* acetocarmine squash preparations of preserved leaf tips were made after hydrolyzing them in HCL at 60 °C for 10 min. Photomicrographs were taken from temporary slides under the magnification of 10x X Oil. Voucher specimens of the taxa investigated have been deposited in KASH (Kashmir University Herbarium).

Bharti Razdan (✉)

Department of Botany,
Govt. Degree College, Kathua, J&K, India.
email: bhartikampasi27@gmail.com

3. Results

3.1 Morphological Description

3.1.1 *Pteris* L.

A genus with about 200 species extended up to temperate regions in Chile, the Mediterranean region, South Africa, Korea, Japan, Tasmania and New Zealand. In India about 20 species are reported. Some exotics are grown as ornamentals. In Kashmir, *P. cretica* alone is reported.

3.1.2 *Pteris cretica* L.

Grows within dense plant cover. Rootstock erect with long, dark brown fibrous roots. Fronds (Fig. 1) pinnate, 60 to 80 cm. tall, dimorphic, sterile fronds wider than the fertile ones. Pinnae alternate, narrowly lanceolate, 15-20 cm. long scales absent. Sori dark brown, borne on the ventral side of pinnae along their margin and are covered with false indusium. Spore (Fig. 2) yellowish, trilate, tetrahedral 40.6 x 33.6 um in size laesura arm 11.3 um long, perine smooth.

3.1.3 *Dryopteris* Adns.

Dryopteris is large genus of about 150 species. It is widely distributed on all continents and in the pacific islands east to the Hawaiian island and eastern island. The genus is absent from southern South America, central and western Australia and New Zealand. Stewart (1972) has reported ten species of the genus from Kashmir. Different species of the genus possess more or less anthelmintic properties & have been employed as vermifuge.

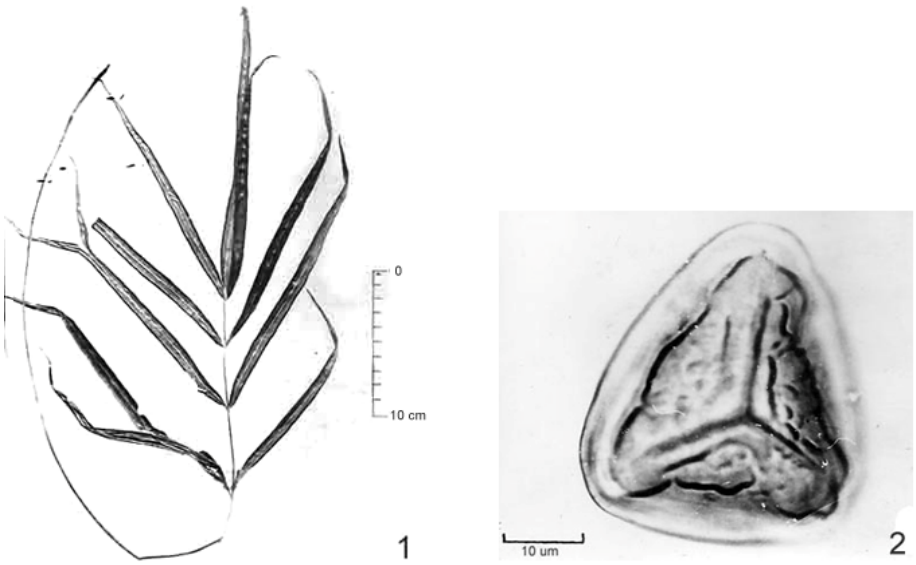

Figure 1 and **2.** *Pteris cretica*: 1. Frond 2. Spore

***Dryoteris odontoma* (More) c. Chr.**

The species grows in the Himalayas & throughout the Kashmir valley at 1,600 to 3,300m. Rootstock short, stout erect clothed with scales. Fronds tufted (Fig 3), erect, densely covered with scales, blade green lancelocate wide in middle tepering towards the apex, bipinnate at the apex pinnules pinnatifid at the base but simple towards the apex. Sori round, dark brown on ventral side of each segment of the pinnule. Scales are of two types: rhizome scales (Fig. 4A) narrowly lanceolate, yellowish with entire margin, cells polygonal with transparent cell lumen, stalk scales (Fig 4B) broadly lanceolate with acuminate apex, yellowish brown, margin entire, basal cells hexagonal and smaller in size than rest of the cells which are polygonal in shape. Lumen of some cells in filled with yellowish brown pigment. Spores (Fig 5) monolete, bilateral, yellowish brown, plane convex in lateral view, perine irregularly folded.

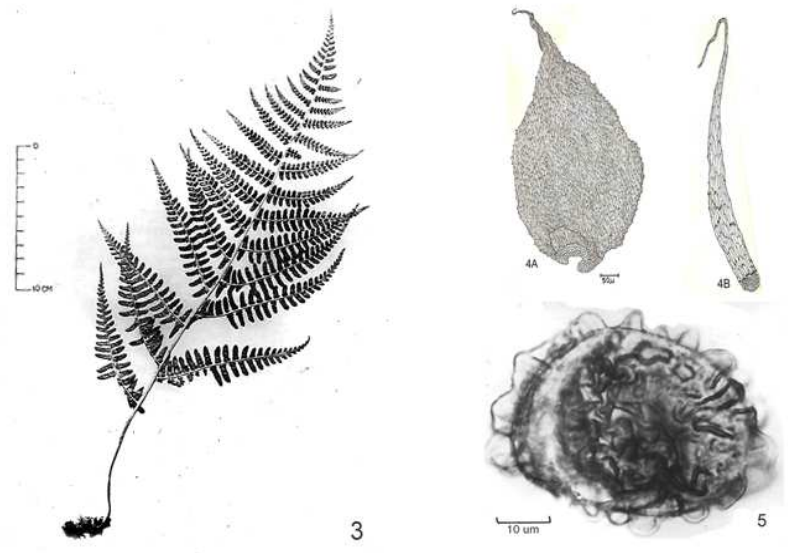

Figure 3, 4 and **5.** *Dryopteris odontoloma*: 3. Frond 4A Rhizome scale 4B Stalk scale 5. Spore

3.2 Cytological observations

Squash preparations of *Pteris cretica* revealed chromosome number n=2n=58 (Fig. 6) per spore mother cell while as that of *Dryopteris odontoloma* revealed n=2n=123 (Fig. 7). In both the species normal course of meiosis was recorded which resulted in formation of only 32 healthy spores per sporangium, indicating apomictic mode of reproduction. 123 chromosomes were observed in the leaf tip cells at metaphase of mitosis.

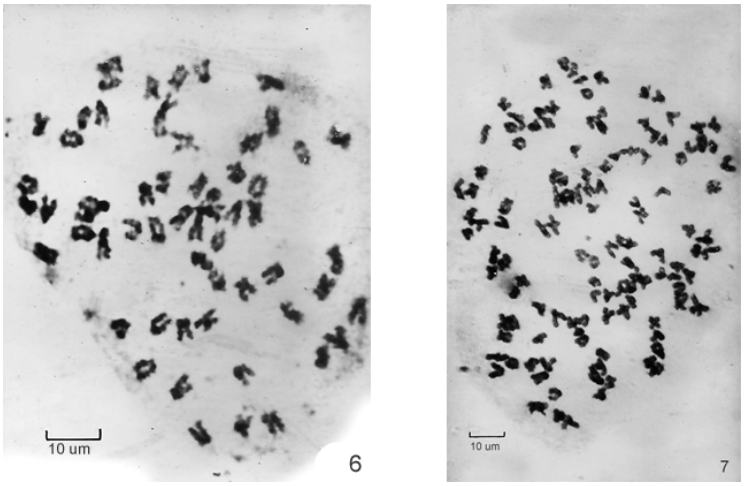

Figure 6 and **7.** Spore mother cells at Diakianesis of meiosis
6. *Pteris cretica* n = 2n = 58 7. *Dryopteris odontoloma* n = 2n = 123

4. Discussion

Manton (1950) has given four possible mechanisms for cytological compensation of apomictic mode of reproduction. The most common method involves a failure of mitotic anaphase at the pre-meiotic stage resulting in doubling of chromosomes. These cells are directly transformed into spore mother cells and because of the presence of two entirely homologous sets of chromosomes the normal pairing phenomenon takes place. Failure of mitotic anaphase results in 8 celled sporangia instead of normal 16-celled which is characteristic feature of sexually reproducing leptosporangiate ferns. Presently the phenomenon of apomixis is reported in diploid *P. cretica* and triploid *D. odontoloma*.

Lair and Sheffield (1986) while working on *P. cretica* reported that inspite of formation of egg, verter canal cell and neck canal cells, the flask shaped archegonia fail to open and spermatozoids are not able to fertilize the egg. The topmost cells of the archegonia collapse which results in loss of archegonial function. Huang et al. (2011) reported that gametophytes of *P. cretica* produce anthredia but no archegonia and young sporophytes are produced directly on the gametopyte without fertilization.

In *P. cretica* 8 sporangia were observed per sporangium each with 58 bivalents at diakinesis. Further stages of meiosis were found to be normal resulting in the formation of 32 well filled spores per sporangium. The existence of this diploid apogamous *Pteris cretica* indicates that it can be a hybrid between two related species with although not complete but much homology between the chromosomes of two gametic sets.

The lowest number reported for the genus *Dryopteris* so far is 41. So 41 is considered as the base number of the genus. Mehra (1961) observed that there is not much difference between the diploid sexual and triploid apomict of *D. odontoloma*. 123 bivalent are produced in all the 8 spore mother cells per sporangium with normal stages of meiosis in present triploid apomict, *D. odontoloma.* So it can be explained that two genomes involved in its synthesis possess a fairly close homology.

References

Anderson, L.E. 1954. Hoyer's solution as a rapid permanent mounting medium for bryophytes. *Bryologists*, 51(3): 242-244.

Heilbrown, A. 1932. Polyploidie and generations wechsel. *Ber. Deut. Ges* 50: 289-300.

Huang Y. Hsu, S., Hsieh T., Chou, H., and Chiu, W. 2011. Three *Pteris* species (Pteridaceae, pteridophyta) reproduce by apogamy. *Botanical Studies*, 52: 79-87.

Kanamori, K. 1972. Apogamy in ferns with special reference to the apogamous embryogenesis. *Sci. Rep. T.K.D Sec. B.*, 15: 1-28.

Laird, S. and Sheffield, E. 1986. Anthredia and Archegonia of the Apogamous fern *Pteris cretica*. *Ann. Bot.*, 57 (2): 139-143

Manton, I. 1950. *Problems of cytology and evolution in the Pteridophyta*. Cambridge Univ. Press., Landon.

Mehra, P.N. 1961. Cytological evolution of ferns with particular reference to Himalayan forms. Presidential address, Botany section, 48th Ind. Sci. Conrg, Roorkee.

Park, C.H and Kato, M. 2003. Apomixis in the interspecific triploid hybrid fern *Cornopteris christenseniana* (woodsiaceae) *J. Plant Res*., 116: 93-103.

Stewart, R.R. 1972. An annotated catalogue of the vascular plants of West Pakistan and Kashmir. In: *Flora of West Pakistan* (eds. Nasir, E. and Ali, S.I.), Karachi.

Walker, T.G. 1962. Cytology and Evolution in the fern genus *Pteris*, L. *Evolution*, 16: 27-43.