

New records of Pteridophytes for Kashmir Valley, India

SHAKOOR A. MIR¹, ANAND K. MISHRA¹, ZAFAR A. RESHI², M. P. SHARMA^{1,♥}

¹Department of Botany, Jamia Hamdard, Hamdard Nagar, New Delhi-110062, India. Tel: +91-9968172445; ♥email: mps_2k@hotmail.com.

²Department of Botany, University of Kashmir, Hazratbal, Srinagar-190006, Jammu and Kashmir, India

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ABSTRACT

Mir SA, Mishra AK, Reshi ZA, Sharma MP. 2014. New Records of Pteridophytes for Kashmir Valley, India. *Biodiversitas* 15: 131-136. During the recent field survey of district Shopian four species of Pteridophytes are reported for the first time that constitutes new records for Kashmir valley. These species are *Hypolepis polypodioides* (Blume) Hook, *Pteris stenophylla* Wall. ex Hook. & Grev., *Dryopteris subimpressa* Loyal and *Dryopteris wallichiana* (Spreng.) Hylander. The diagnostic features of *H. polypodioides* are presence of long-creeping slender rhizome and eglandular, colorless or brown tinged hairs throughout the frond. *P. stenophylla* is characterized by having dimorphic fronds and 3 to 5 pinnae clustered at stipe apex. *D. subimpressa* is marked by pale-green lamina and the largest basiscopic basal pinnule in the lowest pair of pinnae. Similarly, the characteristic features of *D. wallichiana* are presence of huge frond size, glossier and dark-green lamina and dense brown scales in stipe and rachis. In present communication taxonomic description, synonyms, ecology and photographs are provided for each of these newly recorded species.

Key words: Kashmir Valley, new record, Pteridophytes, Shopian.

INTRODUCTION

Pteridophytes are group of seedless and spore producing plants, formed by two lineages, Lycophyta-fronds with no leaf gap in the stem stele and monilophytes-fronds with leaf gap in the stem stele (Pryer et al. 2001, 2004; Smith et al. 2006). They occupy unique position in the plant kingdom and are enormously fascinating from the angle of phylogenetic and morphological characters, bridging the gap between non-seed-bearing bryophytes and seed-bearing vascular plants. They constituted an important part of earth's flora for millions of years (Pryer et al. 2001) and are today widely distributed in tropic and temperate regions, especially at higher elevations. Total number of Pteridophyte species are estimated to be 15,000 among which approximately 9600 ferns and 1400 Lycophytes are described worldwide (Chapman 2006; Smith et al. 2006, 2008). Of these species enumerated in the world, Indian landmass, which is one of the richest nations in terms of biological diversity and is counted among the 18 identified mega biodiversity countries of the world, harbors 1100 species (Fraser-Jenkins 2012). The major centers of their distribution being the Himalayas and the Western Ghats out of nine phytogeographical regions of India as reported by Chatterjee (1939).

Kashmir valley is an integral but geologically 'younger' part of main Himalayan range. It is enclosed by lofty mountains of the Pir Panjal range in the south and southwest, the greater Himalayan range in north and east. Total area of the valley is 15,948km² with 64% being mountainous (Dar et al. 2002). The altitude of the valley plain at its summer capital, Srinagar is 1,675m above mean

sea level (Dar et al. 2002) and the highest peak is that of the 'Kolahoi or Gwashibror' with an elevation of 5,420m. Because of topographical, altitudinal and geographical variation, the valley portrays great habitat diversity and harbors rich floristic diversity of immense scientific interest and economic potential. However, the published literature on flora of Kashmir showed that only Phanerogams are well documented. Cryptogams, especially Pteridophytes have received little attention in the past with regards to their survey and inventorization and thus, have not been examined thoroughly (Dar et al. 2002). The workers that surveyed Pterido-flora of Kashmir valley are Clarke (1880), Beddome (1883, 1892), Hope (1903), Stewart (1945, 1951, 1957, 1984), Handa et al. (1947), Javeid (1965), Kapur and Sarin (1977), Dhir (1980), Kapur (1985) and Khullar (1994, 2000). Nonetheless, their collective contribution resulted in the discovery of only 90 species and 4 varieties of Pteridophytes from Kashmir division (Dar et al. 2002). The Stewart's Catalog (Stewart 1972) nevertheless remained a prime source. In the recent, Wani et al. (2012) presented an up-to-date account of fern and fern allies of Kashmir valley, Gurez and Ladakh, yet reported only total of 106 taxa. To explore possibility of new records in the valley, this study is undertaken in the district Shopian.

MATERIALS AND METHODS

Study area

Shopian is a hilly district situated in the south and south-west of Kashmir valley in the close vicinity of Pir-

Panjal range between latitude of 33°20' and 34°54' North and longitude of 73°35' and 75°35' East with an elevation of 1600 to 4500 meters above mean sea level. Total area of the district is 812.70 km², of which more than half 442.98 km² is under forests, meadowlands, glaciers, subalpine and alpine zone. Daily average temperature ranges from maximum 32°C and minimum 15°C during summer to a maximum of 4°C and minimum of -4°C during winter (Bhat et al. 2012). The region receives an annual precipitation of about 1050 mm mostly in the form of snow. According to Raza et al. (1978), the district possess three major categories of soils namely hill soils, alluvial soils and karewa soils. Great altitudinal variation and contours of hills shape the district into a gradually heightening slope with a wavy appearance that adds magnificent variation in vegetation. These edaphoclimatic variations, mountain slopes and terraces, permanent glaciers, large number of stream and streamlets and significant precipitation build many ideal sites for the luxuriant growth of pteridophytes in this district. The outline of study area is shown in Figure 1.

Regular field trips were carried out in district Shopian and its adjacent area for the collection of pteridophytes diversity during 2010 to 2012. On the survey we not only confirmed the presence of the various species reported earlier by various workers from other parts of Jammu and Kashmir, but also discovered four more species that are new to the pteridoflora of Kashmir valley. These four species are *Hypolepis Polypodioides*, *Pteris stenophylla*, *Dryopteris subimpressa* and *Dryopteris wallichiana* that were identified by the relevant literature and authenticated from Botanical Survey of India, Dehradun. The voucher

specimens are deposited in Department of Botany, Jamia Hamdard and in the Herbarium of University of Kashmir (KASH).

RESULTS AND DISCUSSION

A detailed account comprising taxonomic descriptions, synonyms, distribution and figures of these newly recorded species is provided hereunder:

Hypolepis polypodioides (Blume) Hook., Sp. Fil. 2: 63 (1852).

Synonym: *Cheilanthes polypodioides* Blume, Enum. Pl. Javae 2: 139 (1828); *Hypolepis coerulescens* A. Biswas J. Econ. Taxon. Bot. 7: 121 (1985); *Hypolepis gamblei* A. Biswas J. Econ. Taxon. Bot. 7: 124 (1985); *Hypolepis indica* A. Biswas J. Econ. Taxon. Bot. 7: 112 (1985); *Hypolepis sikkimensis* A. Biswas J. Econ. Taxon. Bot. 7: 122 (1985); *Hypolepis viridula* A. Biswas J. Econ. Taxon. Bot. 7: 123 (1985).

Family: Dennstaedtiaceae

Description: Rhizome slender, long-creeping, woody, thick, 0.3-0.4 cm, hairy; hairs short brown. Stipes long 50 cm or more, dark-brown at base turning light in the distal region, hairy; hairs eglandular, colorless or brown tinged. Lamina 3 pinnate, ovate to deltate, 40-70 cm long & 20-40 cm broad, herbaceous, hairy on both surfaces; pinnae ca. 15 pairs, the large lower pinnae opposite, upper pinnae often alternate, petiolate, lanceolate to deltate; pinnules 12-18 pairs, basiscopic pinnules larger than the acroscopic ones, lanceolate, margin lobed to the costae; ultimate segments

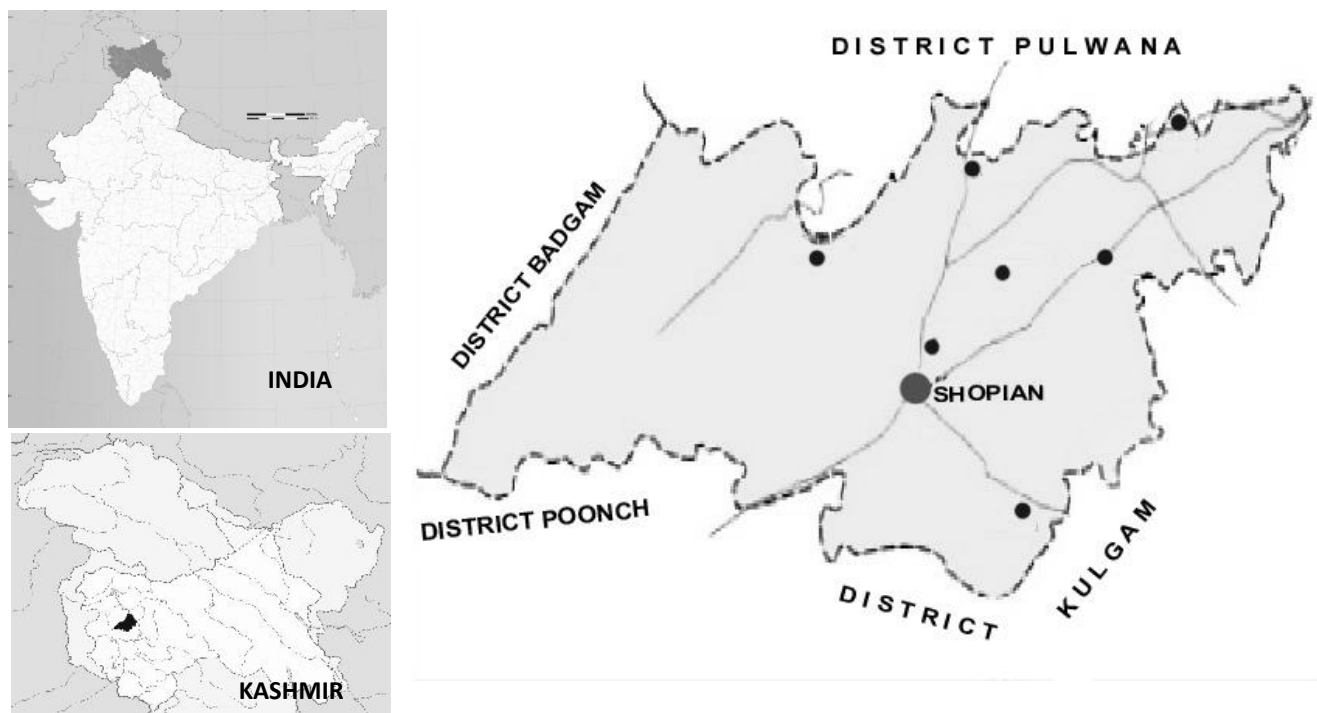


Figure 1. Research site "Shopian" located at south-west of Kashmir, Jammu and Kashmir, India

oblong, ca. 10 pairs, 1cm long by 0.5 cm broad, apex rounded, margin crenate or lobed, often reflexed; rachis dark-brown and course, grooved, hairy, hairs as on stipe. Veins free, simple or forked. Sori exindusiate, round, intramarginal, 2-6 pairs per pinnule, unprotected, partially protected by reflexed teeth. Spores yellowish brown, exine uniformly spinulose. Chromosome number $n=104$.

Figure 2: A, B & C

Habit and Habitat: Terrestrial; growing among large boulders on sandy soil near streams.

Altitudinal distributional range and localities of occurrence: 1600-2200 meter; Kund, Rambhara

Specimen examined: Kund, 2025 m elevation, 27.09.2011, SAM 907 (KASH).

Distribution: Bangladesh, Myanmar, China, Indonesia, Laos, Malaysia, Nepal, Philippines, Taiwan, Thailand, Vietnam, India (Arunachal Pradesh, Dehradun, Garhwal, Himachal Pradesh, Manipur, Sikkim, Uttar Pradesh, South India, Jammu division (Dixit 1984; Khullar 1994; Chandra 2000)).

Pteris stenophylla Wall. ex Hook. & Grev., Icon. Filic., 2: t. 130 (1829).

Synonyms: *Pteris cretica* L. var. *stenophylla* (Wall. ex Hook. & Grev.) Baker, Syn. Fil. 154 (1867); *Pteris pellucida* Presl. var. *stenophylla* (Wall. ex Hook. & Grev.) C.B. Clarke, Trans. Linn. Soc. London, Bot. 1 (7): 463 (1880).

Family: Pteridaceae

Description: Rhizome very short, creeping, thin, 3-4 mm, scaly: scales dark-brown, lanceolate. Fronds dimorphic, clustered. Stipes ca. 20 cm long, stramineous, thin, 1-2 mm, base scaly, upward glabrescent, scales as on rhizome. Lamina pinnate, digitate, 15-20 cm long, texture subcoriaceous, glabrous; pinnae ca. 3 or 5, clustered at stipe apex, linear-lanceolate in shape, up to 20 cm long, 1-2 cm broad, base cuneate, margin sub-entire and undulate in lower part, serrate upwards, the dentations oblique, rather sharp, papery or thicker, apex long acuminate, dimorphic; fertile pinnae narrower (ca. 0.7 cm) than sterile ones, infertile apex is small and coarsely dentate-serrate; veins simple or forked, reaching the margin, mid-vein straw-colored, convex adaxially. Sori indusiate, marginal, indusia continuous. Spores brown. Chromosome number $n=29$.

Figure 2: D, E & F

Habit and Habitat: Terrestrial; growing among dry rocks in open forests

Altitudinal distributional range and localities of occurrence: 2000-3000 meter; Kund, Kellar.

Specimen examined: Shopian, Kellar, 2400 m elevation. 15.10.2011, SAM 820 (KASH).

Distribution: Bhutan, Nepal, Philippines, India (Himachal Pradesh, Uttar Pradesh, Uttarakhand, Jammu Division (Dixit 1984; Khullar 1994; Chandra 2000)).

Dryopteris subimpressa Loyal, Nova Hedwigia 16: 467 (1968).

Synonyms: *Dryopteris submarginata* Loyal Caryologia 18(3): 473 (1965).

Family: Dryopteridaceae

Description: Rhizome long-ascending, scaly, stout. Stipe long, ca. 30 cm, very base blackish, rest stramineous, base densely clothed with scales; scales pale brown, ovate, adnate, margin entire, apex acute, gradually smaller and sparser upward; rachis abaxially brownish, adaxially stramineous, very sparsely scaly. Lamina 2 to 3-pinnate, deltoid-lanceolate, ca. 40 cm long and 30cm broad, widest at base, apex acute, pale green, thinly leathery, glabrous on both surfaces; pinnae ca. 17 pairs, up ca. 16 cm long, 8 cm broad (largest), triangular-lanceolate, petiolate, alternate, basal pair largest, tapering upwards, apex acuminate; pinnules ca. 13 pairs, obliquely spreading, narrowly oblong-lanceolate, alternate, distant, pinnules petiolate towards lower half, adnate half-way above, basal basisopic pinnule of lowest pinnae largest ca. 5 cm long, base 1.6 cm wide (at base), gradually smaller and narrower upward, apex acute with dentate projections, margin lobed to pinnate; pinnulets (lobes) many, deltoid-oblong, margin serrate, apex obtuse or truncate, sharply serrate. Veins 10-12 pairs per pinnule, raised abaxially, impressed adaxially, costae and costule sparsely fibrillose and scales. Sori indusiate, rounded, 4-6 pairs per pinnule, terminal on veins, large, in 1 row on each side of costule and close to it; indusia brownish, rounded-reniform, thick, persistent, thick, glabrous. Spores light-brown, perinate, perine folded. Chromosome number $n=41$.

Figure 2: G, H & I

Habit and Habitat: Terrestrial; growing along the small stream banks

Altitudinal distributional range and localities of occurrence: 1800-2700 meters; D.K. Pora, Narwani, Zainapora, Turkawangam

Specimen examined: Shopian, D. K. Pora, 1850 m alt., 06.07.2011, SAM 859 (KASH).

Distribution: Nepal, China, India (Himachal Pradesh, Kumaun, Uttarakhand, Sikkim, West Bengal) (Dixit 1984; Khullar 2000; Chandra 2000).

Dryopteris wallichiana (Spreng.) Hylander, Bot. Notis: 352 (1953).

Synonyms: *Aspidium paleaceum* Lag. ex Sw., Syn. Fil. 52 (1806); *Aspidium parallelogrammum* Kunze, Linnaea 13: 146 (1839); *Aspidium wallichianum* Spreng., Syst. Veg. 4(1): 104 (1827); *Dryopteris doniana* Ching, Sunyatsenia 6(1): 3-4 (1941); *Dryopteris doiana* Tagawa, Acta Phytotax. Geobot. 5(4): 253-254 (1936); *Dryopteris himalaica* (Ching & S.K. Wu) S.G. Lu, Acta Bot. Yunnan. 13(1): 40 (1991); *Dryopteris quatanensis* Ching, Wuyi Sci. J. 1(1): 6 (1981); *Dryopteris ursipes* Hayata, Icon. Pl. Formosan. 5: 291-293, f. 116 (1915); *Dryopteris filix-mas* var. *paleacea* Druce, List Brit. Pl. 87 (1908); *Dryopteris cyrtolepis* Hayata, Icon. Pl. Formosan. 4: 149-150, f. 89 (1914); *Dichasium parallelogrammum* (Kunze) Fee, Mem. Foug. 5: 303, pl. 23B, f. 1 (1852); *Lastrea patentissima* (Wall. ex Kunze) J. Sm., J. Bot. (Hooker) 4: 193 (1842); *Lastrea parallelogramma* (Kunze) Liebm., Kongel. Danske Vidensk. Selsk. Skr., Naturvidensk. Math. Afd., ser. 5 1: 271 (1849); *Nephrodium patentissimum* (Wall. ex Kunze) C.B. Clarke, J. Linn. Soc., Bot. 15(83): 156-157 (1877);



Figure 2. A, B, C: *Hypolepis polypodioides*; D, E, F: *Pteris stenophylla* G, H, I: *Dryopteris subimpressa*; J, K, L: *Dryopteris wallichiana*

Nephrodium parallelogrammum (Kunze) C. Hope, J. Bombay Nat. Hist. Soc. 14: 728-729 (1903); *Aspidium crinitum* M. Martens & Galeotti Nouv. Mem. Acad. Roy. Sci. Bruxelles 15(5): 66 (1842); *Lastrea filix-mas* var. *parallelogramma* (Kunze) Bedd. Handb. Ferns Brit. India, 249 (1883).

Family: Dryopteridaceae

Description: Rhizome erect, massive, bearing several fronds in whorled fashion, densely clothed with brown, lanceolate scales. Fronds evergreen, monomorphic, shuttlecock shaped. Stipes short, ca. 14 cm, stramineous, very densely scaly; scales at stipe base blackish mixed with pale ones, scales upwards along with rachis light-brown to paler, mixed with few blackish ones, scale base usually dark, scales lanceolate to narrowly lanceolate, margins with projections, apex acuminate; rachis densely scaly and fibrillose; Lamina 1-pinnate- pinnatisect, green to deep-green, lanceolate to oblong-lanceolate, large, ca. 70 cm long and 22 cm broad, base narrowed, glabrous abaxially, scanty scaly on abaxial side, coriaceous in texture; pinnae numerous, 30-38 pairs, alternate, middle pinnae large, 11 cm long and 1.8 cm broad, broadest at base, apex acute, lanceolate, shortly petiolate, margin deeply lobed, sometimes pinnate, lower pinnae reduced; pinnules (lobes) up to 22 pairs, rectangular, obliquely spreading, roundly truncate to truncate at apex, apex toothed, basal pair of pinnules clearly separate from next to it, other pinnules are joined by a narrow wing, basal basicopic pinnule with an auricle towards below. Veins free, forked; costae and costules grooved above, groove continuous from rachis to costae, scaly and fibrillose. Sori indusiate, round, 4-5 pairs per pinnule, in a single row on either side of pinnule, medial, 2/3rd of frond is fertile; indusia dark-brown, reniform falling off at maturity, glabrous, entire. Spores brownish, perinate, perine granulate. Chromosome number n=41.

Figure 2: J, K & L

Habit and Habitat: Terrestrial; growing on Forest floor

Altitudinal distributional range and localities of occurrence: 2000-3500 meters; Huran, Dubjan, Peergali

Specimen examined: Shopian, Dubjan, 2725 m alt., 23.07.2011, SAM 929 (KASH).

Distribution: Mexico, Jamaica, Cuba, Brazil, Argentina, China, Tibet, Bhutan, Nepal, Taiwan, Myanmar, Japan, Vietnam, Philippines, Borneo, Java, India (Himachal Pradesh, Uttarakhand, Uttar Pradesh, Sikkim, Meghalaya, Arunachal Pradesh) (Dixit 1984; Khullar 2000; Chandra 2000).

Discussion

Pteridophytes inhabit a great variety of substrates, climates, and light regimes, both in habitats dominated by flowering plants and those where few angiosperms can survive. Owing to the vast variety of edapho-climatic and physiographic heterogeneity and diverse habitats including lakes, springs, swamps, marshes, rivers, cultivated fields, orchards, subalpine and alpine meadows, mountain slopes and terraces, permanent glaciers, etc., the Kashmir valley

harbors robust diversity of almost all groups of plants. The valley also contains vast diversity of plant species that are distinct from those in the rest of the country and endemic to this region. Different researchers have contributed to the study of pterido-flora of Kashmir valley; however, Ralph Randles Stewart (1972) is utmost fern collector of this realm. Recently, Wani et al. (2012) presented an up-to-date account of fern and fern allies of Kashmir valley, Gurez and Ladakh and cited a total of 106 taxa. The authors also included ecological status, phytogeographical affinity and the distributional data of collected ferns.

During the current extensive field surveys carried out in different regions of district Shopian and its adjacent area a good number Pteridophyte species were collected, out of which four species have been reported for the first time from the study area that makes up new records for the Kashmir valley. There are no earlier reports of their collection from the valley. However, these species have been reported from other parts of the world and also from different regions of India. The two species viz., *Dryopteris subimpressa* and *Dryopteris wallichiana* are new to the Jammu and Kashmir state, whereas *Hypolepis polypodioides* and *Pteris stenophylla* had earlier been reported from the Jammu division. The distinguishing features of *Hypolepis polypodioides* are presence of long-creeping slender rhizome and eglandular, colorless or brown tinged hairs throughout frond. *Pteris stenophylla* differs from its close relative *Pteris cretica* in having dimorphic fronds and the presence of only 3 or 5 pinnae clustered at stipe apex. Similarly *D. subimpressa* is characterized by the presence of pale-green lamina and in bearing the largest basicopic basal pinnule in the lowest pair of pinnae. The *Dryopteris wallichiana* contrasts from its close relatives, *D. redactopinnata* and *D. xanthomelas* in having huge frond size reaching up to meters; glossier and dark-green lamina; and browner and dense scales in stipe and rachis.

CONCLUSION

In addition to a good number of species, four species of pteridophytes namely; *Dryopteris subimpressa*, *Dryopteris wallichiana*, *Hypolepis polypodioides* and *Pteris stenophylla* were collected for the first time from Kashmir valley, which are discussed in the present communication. This study is expected to act as a stepping stone for further floristic studies and their need for studying the Pteridophyte diversity in other parts of Jammu and Kashmir State. In addition, field survey is a primary methodology to assess plant communities that furnish the basic information required for conservation of biodiversity.

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REFERENCES

- Beddome RH. 1883. Handbook to the ferns of British India, Ceylon and Malay Peninsula. Thacker Spink and Co, Calcutta.
- Beddome RH. 1892. Supplement to the ferns of British India, Ceylon and Malay Peninsula. Thacker Spink and Co, Calcutta.
- Bhat TA, Nigam G, Majaz M. 2012. Study of some medicinal plants of the Shopian District, Kashmir (India) with emphasis on their traditional use by Gujjar and Bakerwal Tribes. *Asian J Pharm Clin Res*, Vol 5, Suppl 2: 94-98.
- Chandra S. 2000. The Ferns of India, Enumeration, Synonyms & Distribution. International Book Distributors, Dehra Dun, India.
- Chapman AD. 2006. Numbers of Living Species in Australia and the World. Report for the Department of the Environment and Heritage, Canberra, Australia.
- Chatterjee D. 1939. Studies on the endemic flora of India and Burma. *J Asiat Soc Bengal (Sci.)* 5: 19-68.
- Clarke CB. 1880. A Review of ferns of Northern India. *Trans Linn Soc (Bot) London* 1: 425-611.
- Dar GH, Bhagat RC, Khan MA. 2002. Biodiversity of the Kashmir Himalaya. Anmol Publications Pvt Ltd, New Delhi.
- Dhir KK. 1980. Ferns of North Western Himalayas. *Bibliotheca Pteridologia*. 1: 1-158.
- Dixit RD. 1984. A Census of Indian Pteridophytes, Flora of India IV. Bot Surv India, Howrah, Calcutta, India.
- Fraser-Jenkins CR. 2012. Rare and threatened Pteridophytes of Asia 2. Endangered species of India-the higher IUCN Categories. *Bull Natl Mus Nat Sci Ser B* 38 (4): 153-181.
- Handa KL, Kapoor LD, Chopra IC. 1947. Male ferns of Kashmir. *Curr Sci* 16: 55-56.
- Hope CW. 1903. The ferns of Northwestern India including Afghanistan the Trans-Indus Protected Areas & Kashmir. *J Bombay Nat Hist Soc* 14: 720-749.
- Javeid GN. 1965. Some ferns & ferns allies of Srinagar, Kashmir. *Science* 2: 90-100.
- Kapur SK, Sarin YK. 1977. Useful medicinal ferns of Jammu & Kashmir. *Indian Drugs* 14: 136-140.
- Kapur SK. 1985. Contribution to the Pteridophytic flora of the Jammu and Kashmir. *J Econ Tax Bot* 6: 503-514.
- Khullar SP. 1994. An Illustrated Fern Flora of West Himalaya Vol. I (Botrychiaceae to Aspleniaceae). International Book Distributors, Dehradun, India.
- Khullar SP. 2000. An Illustrated Fern Flora of West Himalaya. Vol. II. International Book Distributors, Dehradun, India.
- Pryer KM, Schneider H, Smith AR, Cranfill R, Wolf PG, Hunt JS, Sipes SD. 2001. Horsetails and ferns are a monophyletic group and the closest living relatives to seed plants. *Nature* 409: 618-622.
- Pryer KM, Schuettpelz E, Wolf PG, Schneider H, Smith AR, Cranfill R. 2004. Phylogeny and evolution of ferns monilophytes with a focus on the early Leptosporangiate divergences. *Am J Bot* 91: 1582-1598.
- Raza M, Ahmad A, Mohammad A. 1978. The valley of Kashmir, a geographical interpretation. Vikas Publication, New Delhi.
- Smith AR, Pryer K, Schuettpelz E, Korall P, Schneider H, Wolf PJ. 2006. A classification for extant ferns. *Taxon* 55: 705-731.
- Smith AR, Pryer KM, Schuettpelz E, Korall P, Schneider H, Wolf PG. 2008. Fern classification. In: Ranker TA, Hafler CH (eds). *Biology and Evolution of Ferns and Lycophytes*. UK, Cambridge University Press, Cambridge.
- Stewart RR. 1945. Ferns of Kashmir Himalaya. *Bull Torrey Bot Club* 72: 399-426.
- Stewart RR. 1951. The ferns of Pehlgam, Kashmir. *J Indian Bot Soc* 30: 137-142.
- Stewart RR. 1957. The fern and fern allies of West Pakistan. *Biologia* 3: 1-32.
- Stewart RR. 1972. An annotated catalogue of the vascular plants of West Pakistan and Kashmir. In: Nasir E, Ali SI (eds). *Flora of West Pakistan*. Fakhri Press, Karachi.
- Stewart RR. 1984. Remarks on North-West Himalayan Ferns. *Indian Fern J* 1: 41-46.
- Wani MH, Shah MY, Naqshi AR. 2012. The ferns of Kashmir-an update account. *Indian Fern J* 29: 100-136.
- Blume CL. 1828. *Enumeratio Plantarum Javae et Insularum Adjacentium*. Fasc. II, Filices. Lugduni Batavarum, Batavia.
- Biswas A. 1985. The genus *Hypolepis* Bernh. in India. *J Econ Taxon Bot* 7: 111-124.