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A Compendium of Papaveraceae *s.l.* In Indian Subcontinent: Its Distribution and Endemism

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Abstract: A preliminary checklist of Papaveraceae *s.l.* in Indian subcontinent has been prepared on the basis of primary observations of different taxa belonging to this family in wild habitats and on secondary observations based on examining herbarium specimens and taxonomic literature. On the Indian subcontinent (comprising Bangladesh, Bhutan, Myanmar, Nepal, Pakistan, Sri Lanka and India), the family Papaveraceae is poorly represented (22.46%). For better understanding of the species dynamics of Papaveraceae in Indian subcontinent, the present status of phytoendemism has been compared to the data of previous investigations done in nineteenth century. On the basis of phytogeographical analysis, economic potential and survival threat, fossil ancestry of Papaveraceae in Indian subcontinent, its mode of phytoendemism has been categorized under Holoendemism as well as Island endemics. The present studies on dynamics of Papaveraceae in Indian subcontinent substantiate its present mode of panendemism or diversification.

Key words: Phyto-endemism, Papaveraceae, Indian subcontinent

INTRODUCTION

Papaveraceae *s.l.* consists of Papaveraceae S.Str. (ca. 23 genera, 240 species); Fumariaceae DC. (16 genera, 500 species); Hypecoaceae L. (1 genus and 18 species) and monogeneric taxon *Pteridophyllum* Sieb. and Zucc. and it is characterized by its paracarpous gynoecium of two or more carpels (Chase, 1998; APG II, 2003; Kadereit *et al.*, 1994, 1995, 1997). The possession of idioblasts or laticifers with watery or milky sap or latex (Friedel, 1938) and calcium oxalate crystals in the inner epidermis of the outer integument of the seeds (Brueckner, 1985) support Fumariaceae/Hypecoaceae and Papaveraceae S.Str. as monophyletic. Though *Pteridophyllum* is devoid of these two characters, yet its association with Hypecoaceae has been established by the presence of four unspurred petals and four stamens in these groups (Fedde, 1909, 1936). Hypothesis of Kadereit *et al.* (1994, 1997) have circumscribed *Pteridophyllum* as basal clad of Papaveraceae *s.l.* for two characteristics: possession of two sepals and bicarpellate gynoecium.

From the review of geographical distribution, Papaveraceae *s.l.* has been considered to be originated and diversified in Laurasia in geological past (Raven and Axelrod, 1974, 1978; Kadereit, 1988a, 1990, 1993a). Papaveraceae *s.l.* with the members of herbs and shrubs, distributed mostly in temperate and sub-tropical region of N. America, Europe, Asia, Australia and South Africa, having 42 genera and about 690 species (Debnath and

Nayar, 1993; Ellis and Balakrishnan, 1993; Grey Wilson, 1993; Hoot *et al.*, 1997; Kadereit, 1886a, b, 1987, 1988b, 1993a, b, 1996; Liden, 1989, 1991, 1995; Ryberg, 1960; Zhuang, 1993; Zuloaga and Morrone, 1996; Liden, 1998; Wu, 1999; Carolan, 2004). Most of the times Papaveraceae *s.l.* has been studied under four subfamilies: Chelidonioideae (Old world/New World); Eschscholzioideae (New World); Papaveroideae (Old World/New World) and Platystemonoideae (New World) (Schwarzbach and Kadereit, 1994; Hoot and Crane, 1995; Jork and Kadereit, 1995; Kadereit *et al.*, 1995, 1997; Carolan *et al.*, 2006). To have an idea about relative age of extant taxa, ecological analysis of a family is necessary. It is interesting to notice that *Pteridophyllum*, parts of Fumariaceae tribe Corydaleae *p.p.* and most members of Papaveraceae S.Str. subfam. Chelidonioideae occur in forest floor and ecologically related habitat; whereas rest of the family: Hypecoum, Fumariaceae tribe Corydaleae *p.p.*, tribe Fumarieae, Papaveraceae subfam. Eschscholzioideae and Papaveroideae incl. Platystemonoideae and *Glaucium/Dicranostigma* are distributed in arid land, open and disturbed habitats and this transition from forest floor to open habitat has been taken place few times where stimulus like aridification, morphological divergence played the key roles (Schwarzbach and Kadereit, 1994; Kadereit *et al.*, 1995). According to the hypothesis of Stebbins (1952), arid surroundings might have three major effects on evolution of plants. (i) when moisture is limited, local diversity in

soil and other environmental factors has a great effect on the vegetation than in the regions where moisture is adequate; (ii) The division of larger sized populations into smaller sized units which are isolated from each other is favored (iii) Selection for specialized structures which helps plants to withstand severe droughts is strong. A modified version of these hypothesis have been put forwarded by Stebbins (1952, 1972, 1975) and Axelrod (1967, 1972) who envisaged that high degree of morphological diversion in arid and semi-arid region might be due to rapid morphological evolution in those areas like diversification and fragmentation of populations leads to geographic isolation followed by natural selection and adaptive radiations push further quantum-evolution. The high degree of morphological divergence in generic level has been explained under fast radiation hypothesis by Macnair (1989), who explained that rapid speciation could occur in response to adaptive challenge when colonizers are faced with vacant adaptive niches and speciate to fill them. It is interesting to notice that ecological divergence has been noticed in the generic level of the family Papaveraceae *s.l.*; 16 of 23 genera (220 of 240 species) of Papaveraceae *S.Str.* grows in arid and open habitat whereas 250-300 species of *Corydalis* of Fumariaceae DC. prefer to grow on forest floor (Liden, 1986; Liden *et al.*, 1995) and those taxa extant in open habitats would have been considered younger than the groups growing on forest floor (Raven and Axelrod, 1974, 1978). However, in Old World and New World, the horticultural as well as economic potential of the members of Papaveraceae *s.l.* should be considered as genetic resource from regional economic aspects; naturally members of this family deserve proper conservation. Apart from ethno botanical importance, the underexploited genetic resources belonging to this family deserve conservation which is on the verge of depletion of wild habitats. The lack of contemporary phytogeographical analysis of Papaveraceae in South Asian region, which is pre-requisite criteria to adopt conservation strategies on a national level as well as regional level, lead to undertake the present studies. The last phytogeographical review of this family on the Indian subcontinent was done in 1939-40 (Chatterjee, 1939, 1962). Thus an appraisal is necessary to monitor the species dynamics of Papaveraceae in the same geographical location after a period of time. Species dynamics is a key indicator in predicting whether a particular group of plants is in a mode of expansion or extinction. Apparently, it is an academic study where economic potential of an under-exploited group of plants is not taken into consideration. Hence, species dynamics should be considered as an important parameter in determining sustainable utilization

pattern as well as planning of conservation strategies. For a developing country, underexploited plant resource should be considered as potential natural resource, which could play an important role in socio-economic development. But, most of the time it has been found the conservation initiative, strategies, ethics in developed countries is much more pro-active than developing countries, where underexploited plant is being considered as a potential resource, whereas it is just weed-like plant in other world.

MATERIALS AND METHODS

To prepare a preliminary checklist of Papaveraceae in Indian subcontinent, available floristic works of Indian subcontinent and other major regions have been consulted, starting with Index Kewensis (Hooker and Jackson, 1895) and its supplements. The list of endemic taxa has been prepared from the literature and confirmed from herbaria, viz. ASSAM (BSI, Eastern Circle, Meghalaya), BSIS (Industrial Section of Indian Museum, Botanical Survey of India), CAL (Central National Herbarium, Botanical Survey of India), DD (Herbarium Divn. Forest Research Institute, DehraDun), BSD (Botanical Survey of India, Northern Circle, DehraDun), CDRI (Botany Divn. Central Drug Research Institute, Lucknow), CIMAP (Herbarium, Central Institute of Medicinal and Aromatic Plants, Lucknow), RRCBL (RRL, Bangalore), RRLB (RRL, Bhubaneswar) and K (Royal Bot. Gard., Kew). The microfiches of C. Linnaeus's collection from two European herbaria, have also been studied viz. Herbarium, London (LINN) and Herbarium, Stockholm (S). In search of endemic and threatened taxa, field surveys have been undertaken between 1999-2005 in parts of North-East India, North-West, Western and Central Himalayas in India. The required data on threatened taxa of Papaveraceae were partially accumulated from World Conservation Monitoring Centre, Cambridge; UK. The assortment of endemic taxa of Papaveraceae in different phytocorias has been made following the phytocorial classification of Kundu (2001).

RESULTS AND DISCUSSION

Distribution of Papaveraceae in Indian subcontinent: In India, the family is represented by ca. 9 genera and ca. 93 species (Debnath and Nayar, 1993; Ellis and Balakrishnan, 1993; Rawat, 1997). During present investigation it has been found that there are ca. 97 taxa (87 species and 10 sub-species) under 9 genera belonging to Papaveraceae distributed in India. The checklist of Papaveraceae of

Indian subcontinent (Jaffri and Qaiser, 1974a, b; Whitmore, 1979; Long, 1984a, b; Dahl, 1990; Kadereit, 1993a, b; Kadereit *et al.*, 1994, 1995, 1997; Wu, 1999; Ohba *et al.*, 2006) is given in Table 1.

So, from Table 1, it has been found that there are 155 taxa under 11 genera belonging to Papaveraceae are spatially distributed over Indian subcontinent and other parts of the world.

Table 1: Checklist of Papaveraceae in Indian subcontinent and other places

Name of taxa	Place of occurrence
1. <i>Argemone mexicana</i> L. Sp. Pl. 508, 1753 forma <i>leiocarpa</i> (E. Greene) Ownbey in Mem. Torrey Bot. Club 21 (1): 37. 1958.	: India, Pakistan, U.S.A., Brazil, West Africa, West Indies, Mexico.
2. <i>A. mexicana</i> L., forma <i>mexicana</i>	: India, China, Taiwan, Native of Tropical America.
3. <i>A. ochroleuca</i> Sweet, Brit. Fl. Gard. 3: 242. 1829	: India, Pakistan, Native of Mexico, Naturalized in Africa, Australia, New Zealand and Micronesia.
4. <i>A. subfusiformis</i> Ownbey in Brittonia 13:102. 1961.	: India, Nepal, Bhutan, Bolivia, Ecuador, Peru, Argentina, Chile, Paraguay, Uruguay.
5. <i>Corydalis adiantifolia</i> Hook. f. and Thoms. Fl. Ind. 271. 1855 var. <i>adiantifolia</i>	: India, Pakistan, China.
6. <i>C. adiantifolia</i> Hook. f. and Thoms., var. <i>heterocarpa</i> Jaffri in Fl. W. Pakistan 73: 36. 1974	: India, Pakistan.
7. <i>C. alburyi</i> Ludlow and Stearn in Bull. Brit. Mus. (Nat. Hist.) Bot., 5(2): 49. 1975.	: Nepal.
8. <i>C. alpestris</i> Meyer, Verz. Pfl. Canc. 176. 1831.	: India, Pakistan, Nepal, Bhutan, Central Asia, Caucasus, Turkey.
9. <i>C. aurantiaca</i> Ludlow and Stearn in Bull. Brit. Mus. (Nat. Hist.) Bot., 5(2): 49. 1975.	: Bhutan.
10. <i>C. borii</i> C. Fischer in Bull. Misc. Inf. Kew 1940: 31. 1940.	: India, Myanmar, China.
11. <i>C. boweri</i> Hemsley in J. Linn. Soc. 30: 108. 1894.	: India.
12. <i>C. boweslyonii</i> Long in Notes Roy. Bot. Gard. Edinburg, 42 (1): 99. 1984.	: Bhutan, China.
13. <i>C. brevicarata</i> Ludlow. in Bull. Brit. Mus. (Nat. Hist.) bot., 5(5): 287. 1976.	: Nepal.
14. <i>C. calliantha</i> Long in Notes Roy. Bot. Gard. Edingargh, 42(1): 105. 1984.	: Bhutan.
15. <i>C. cashmeriana</i> Royle, Illus. Bot. Himal. 69 (1834). 1833.	: India, Nepal, Bhutan, China.
16. <i>C. casimiriaca</i> Duthie and Prain in J. Sdist. Soc. Bengal II, 65: 27. 1896.	: India, Nepal, Bhutan, China.
17. <i>C. cavei</i> D. Long in Notes R. Bot. Gard. Edinb. 41 (1): 104. 1984.	: India, Nepal, China.
18. <i>C. chaerophylla</i> DC., Prodr. 1: 128. 1824.	: India, Nepal, Bhutan.
19. <i>C. changuensis</i> D. Long in Notes R. Bot. Gard. Edib. 42 (1): 102. 1984.	: India.
20. <i>C. chasmophila</i> Ludlow and Stearn in Bull. Brit. Mus. (Nat. Hist.) Bot., 5 (2): 52. 1975.	: Nepal, Bhutan.
21. <i>C. clarkei</i> Prain in J. Asiat. Soc. Bengal II, 65: 34. 1896.	: India, Pakistan, China.
22. <i>C. clavibracteata</i> Ludlow and Stearn in Bull. Brit. Mus. (Nat. Hist.) Bot. 5(2): 53. 1975.	: Nepal.
23. <i>C. cornuta</i> Royle, Illus. Bot. Himal. 69. 1834.	: India, Pakistan, Nepal, Afghanistan, China.
24. <i>C. crassifolia</i> Royle, Illus. Bot. Himal. 68. 1834.	: India, Pakistan, China.
25. <i>C. crispa</i> Prain in J. Asiat. Soc. Bengal II, 65: 30. 1896.	: India, Bhutan.
26. <i>C. crithmifolia</i> Royle, Illus. Bot. Himal. 68. 1834.	: India, Pakistan, China.
27. <i>C. delicatula</i> Long in Notes Roy. Bot. Gard. Edinburgh 42 (1): 97. 1984.	: Bhutan, China.
28. <i>C. denticulato-bracteata</i> Fedde Repert. 25: 219. 1928.	: Bhutan.
29. <i>C. diphylla</i> Wall; Tent. Fl. Nap. 54. 1826.	: India, Pakistan, Nepal, Afghanistan.
30. <i>C. dorjii</i> D. Long in Notes R. Bot. Gard. Edinb. 42: 96. 1984.	: India, Bhutan, China.
31. <i>C. drepanantha</i> D. Long in Notes R. Bot. Gard. Edinb. 42: 101. 1984.	: India, Bhutan.
32. <i>C. dubia</i> Prain in J. Asiat. Soc. Bengal II, 65: 36. 1896.	: India, Bhutan.
33. <i>C. dulongjiangensis</i> H. Chuang, Acta bot. Yunnan. 13: 128. 1991.	: Myanmar, China.
34. <i>C. duthiei</i> Maxim, Fl. Tangut. 49: 12. 188. 9.	: India.
35. <i>C. ecristata</i> (Prain) Long, Notes Ro. Bot. Gard. Edinburgh 42(1): 91. 1984. var. <i>ecristata</i>	: India, Nepal, Bhutan, China.
36. <i>C. ecristata</i> (Prain) Long var. <i>longicalcarata</i> Long in Notes Roy Bot. Gard. Edinbargh 42 (1): 93. 1984.	: India, Bhutan, China.
37. <i>C. elegans</i> Hook. f. and Thoms., Fl. Ind. 265. 1855.	: India, Nepal.
38. <i>C. falconeri</i> Hook. F. and Thoms. Fl. Brit. India 1: 124. 1872.	: India, China.
39. <i>C. filicina</i> Prain in J. Asiat. Soc. Bengal II, 65: 30. 1896.	: India, Nepal, Bhutan.
40. <i>C. filiformis</i> Royle, Illus. Bot. Himal. Pl. 65. 1834.	: India, Nepal.
41. <i>C. flabellata</i> Edgew. in Trans. Linn. Soc., Bot. 20: 30. 1851.	: India, Pakistan, Nepal, China.
42. <i>C. flaccida</i> Hook. f. and Thoms. Fl. Ind. 260. 1855.	: India, Nepal, Bhutan, Myanmar, China
43. <i>C. franchetiana</i> Prain in J. Asiat. Soc. Bengal 65: 34. 1896.	: Bhutan, China.
44. <i>C. gerdae</i> Fedde in Fedde Repert. 18: 30. 1922.	: Nepal, Bhutan.
45. <i>C. geraniifolia</i> Hook. f. and Thoms., Fl. Ind. 269. 1855.	: India, Nepal, Bhutan.
46. <i>C. gortschakovii</i> Schrenk, Enum. Pl. Nov. 1: 100. 1841.	: India, Pakistan, Afghanistan, Central Asia.
47. <i>C. govaniana</i> Wall., Tent. Fl. Nap. 55. 1826.	: India, Pakistan, Nepal, China.
48. <i>C. gracillima</i> C.Y. Wu ex Govaerts, World Checkl. Seeds. Pl. 3(1): 20. 1999. var. <i>gracillima</i>	: Myanmar, China.
49. <i>C. griffithii</i> Boiss. ssp. <i>salangensis</i> Wendelbo in Fl. Iran., 110: 16. 1974.	: Pakistan, Afghanistan.

Table 1: Continued

Name of taxa	Place of occurrence
50. <i>C. hamata</i> Franch, in Morot. Journ. De Bot. vii: 291.1894 var. <i>hamata</i> .	: Nepal, Myanmar, China.
51. <i>C. hendersonii</i> Hemsley in J. Linn. Soc. Bot. 30: 108.1894. var. <i>hendersonii</i>	: India, Pakistan, Nepal, China.
52. <i>C. hookeri</i> Prain in J. Asiat. Soc., Bengal ii, 65: 34. 1896.	: India, Nepal, China.
53. <i>C. iochanensis</i> Leville, Cat. Pl. Yunan. 202. 1916.	: Bhutan, China.
54. <i>C. jigmei</i> C.E.C Fischer and K.N. Kaul, Bull Misc. Inform. Kew 1940: 266. 1940.	: India, Bhutan, China.
55. <i>C. juncea</i> Wall., Tent. Fl. Nap. 54, t. 42. 1826.	: India, Nepal, Bhutan, China.
56. <i>C. kingii</i> Prain, J. Asiat. Soc., Bengal II, 65: 30. 1896.	: Bhutan, China.
57. <i>C. laelia</i> Prain in J. Asiat. Soc. Bengal II, 65, 65: 25. 1896, var. <i>laelia</i> .	: India, Pakistan, Bhutan, China.
58. <i>C. lathyroides</i> Prain in J. Asiat. Soc. Bengal II, 65:23. 1896.	: India, Nepal, Bhutan.
59. <i>C. latiflora</i> Hook. F. and Thoms., Fl. Ind., 270. 1855. ssp. <i>gerdae</i> (Fedde) Lid. ex C.Y.Wu, H. Chuang and Z.Y. Su, Fl. Reipubl. Popularis Sin. 32: 277. 1999.	: India, Nepal, Bhutan, China.
60. <i>C. leptocarpa</i> Hook. f. and Thoms., Fl. Ind. 260. 1855.	: India, Bhutan, Myanmar, Thailand, China.
61. <i>C. longipes</i> deCandolle var. <i>pubescens</i> (C.Y. Wu and H. Chuang) C.Y. Wu, Fl. Reipubl. Popularis Sin. 32: 341. 1999.	: Nepal, China.
62. <i>C. lopiensis</i> Franchet, J. Bot. Morot. 8: 823. 1984.	: Myanmar, China.
63. <i>C. megacalyx</i> Ludlow and Stearn in Bull. Brist. Mus. (Nat. Hist.), Bot. 5(2): 58. 1975.	: Nepal.
64. <i>C. meifolia</i> Wall., Tent. Fl. Nap. 55, t. 41. 1826.	: India, Pakistan, Nepal, Bhutan, China.
65. <i>C. mitae</i> Kitamura in Acta Phytotax. and Geobot. Kyoto, 16: 2.1955.	: Nepal.
66. <i>C. moocroftiana</i> Wall. ex Hook. f. and Thoms. Fl. Ind. 1: 266. 1855.	: India, Pakistan, Afghanistan, China.
67. <i>C. mucronifera</i> Maxim., Fl. Rangun. 1: 51, 1889.	: India, Bhutan, China.
68. <i>C. murreeana</i> Jafri in Fl. W. Pakistan, 73: 7. 1974.	: Pakistan.
69. <i>C. nana</i> Royle, Illus., Bot. Himal. 68. 1834.	: India, Nepal.
70. <i>C. nepalensis</i> Kitamura in Acta Phytotax. and Geobot., Kyoto. 16: 273. 1955.	: Nepal.
71. <i>C. oligantha</i> in Bull. Brit. Mus. (Nat. Hist.) Bot. 5: 60. 1975.	: India, Bhutan, Myanmar, China.
72. <i>C. ophiocarpa</i> Hook. f. and Thoms. Fl. Ind. 259. 1855.	: India, Bhutan, China, Taiwan, Japan.
73. <i>C. pachypoda</i> (Franch.) Hand.-Mazz. Symb. Sin Pt. vii. 347. 1931.	: Nepal, China.
74. <i>C. pakistanica</i> Jafri in Fl. W. Pakistan 73: 26. 1974.	: India, Pakistan.
75. <i>C. polygamina</i> Hook. f. and Thoms. Fl. Ind. 263. 1855. var. <i>poygalina</i>	: India, Nepal, Bhutan, China.
76. <i>C. pseudocribrimifolia</i> Jafri in Fl. W. Pakistan 73: 12. 1974.	: India, Pakistan.
77. <i>C. pseudojuncea</i> Ludlow., in Bull. Brit. Mus. (Nat. Hist.) Bot. 5: 62. 1975.	: India, Nepal, China.
78. <i>C. saltatoria</i> W. W. Smith in Notes Bot. Gard. Edinb 10: 20. 1917.	: Myanmar.
79. <i>C. pseudolongipes</i> Liden in Bull. Brit. Mus. (Nat. Hist.) Bot. 18: 532. 1989.	: India, Nepal, Bhutan, Bangladesh, China.
80. <i>C. pterygopetala handel-Mazzetti</i> Anz. Akad. Wiss. Wien, Math-Nat. 62: 222. 1925.	: Myanmar, China.
81. <i>C. shakya</i> Liden in Bull. Brist. Mus (Nat. Hist.) Botany 18: 519. 1989.	: India, Nepal.
82. <i>C. sikkimensis</i> (Prain) Fedde, Repert. Spec. Nov. 17: 201. 1921.	: India, Pakistan, Nepal, Bhutan, China.
83. <i>C. staintonii</i> Ludlow and Stearn in Bull. Brit. Mus. (Nat. Hist.), Bot. 5(2): 65. 1975.	: Nepal.
84. <i>C. stewartii</i> Fedde, Repert. Spec. Nov.19: 119. 1923.	: India, Pakistan.
85. <i>C. stracheyi</i> Prain in J. Asiat. Soc. Bengal ii, 65.37. 1896. var. <i>stracheyi</i>	: India, Nepal, Bhutan, China.
86. <i>C. stricta</i> Dc., Syst.Nat.2: 123. 1821.	: India, Nepal, Pakistan, China, Mongolia, C-Asia.
87. <i>C. sykesii</i> Ludlow and Stearn in Bull. Brit. Mus. (Nat. Hist.), Bot., 5(2): 66. 1975.	: Nepal.
88. <i>C. tibetica</i> Hook.f. and Thoms.,Fl.Ind.265. 1855.	: India, Pakistan, China.
89. <i>C. thyrsoflora</i> Prain In J. Asiat. Soc. Bengal II. 65: 35. 1896.	: India, Pakistan.
90. <i>C. trifoliata</i> Franch. In Bull. Soc., Bot., France. 33: 392. 1886.	: India, Nepal, Bhutan, Myanmar, China.
91. <i>C. triternatifolia</i> C.Y. Wu, Acta Bot. Yunnan. 12(3): 280. 1990.	: Myanmar, China.
92. <i>C. vaginans</i> Royle, Illus. Bot. Himal. 69. 1834.	: India, Pakistan, Nepal, Afghanistan.
93. <i>C. yunnanensis</i> Franchet, Bull. Soc. Bot. France 33: 394. 1886. var. <i>yunnanensis</i>	: Myanmar, China.
94. <i>Dactylocapnos roylei</i> (Hook. F. and Thoms.) Hutchinson, Bull. Misc. Inform. Kew 1921: 104. 1921.	: India, Nepal, Bhutan, China.
95. <i>D. scandens</i> (D.Don) Hutchinson, Bull. Misc. Inform. Kew 1921:105.1921.	: India, Nepal, Bhutan, Myanmar, China, Indo-Chinese peninsula.
96. <i>D. torulosa</i> (Hook. f. and Thoms.) Hutchinson, Bull. Misc. Inform. Kew 1921: 104. 1921.	: India, China.
97. <i>Dicentra lichiangensis</i> Fedde, in Fedde, Repert. 17: 199. 1921.	: India, Nepal, Myanmar.
98. <i>D. macrantha</i> Oliver, Hooker's Icon Pl.20: t.1937.1890.	: Myanmar, China.
99. <i>D. macrocapnos</i> Prain in J. Asiat. Soc. Bengal 65: 12. 1896.	: India, Nepal, Myanmar.
100. <i>D. paucinervia</i> K. Stearn in Brittonia 13: 45. 1961.	: India, Bhutan.
101. <i>D. ventii</i> Khanh in Fedde, Repert Spes. Nov. 83: 540. 1972.	: India.
102. <i>Dicranostigma lactucoides</i> Hook. f. and Thoms., Fl. Ind. 255. 1855.	: India, Nepal, Bhutan, China.

Table 1: Continued

Name of taxa	Place of occurrence
103. <i>Eschscholzia californica</i> Cham. in Nees, Horae Phys. Berol. 74. 1820.	: India, Pakistan, China, Native of N. America, Mexico, Naturalized in Europe.
104. <i>Fumaria capreolata</i> L., Sp. Pl. 701. 1753.	: India, Europe.
105. <i>F. indica</i> (Haussk.) Pugsley in Linn. Soc., Bot. 44: 313.1919.	: India, Nepal, Bhutan, Pakistan, Afghanistan, West Asia.
106. <i>F. officinale</i> L., Sp. Pl. 700. 1753.	: India, Europe, Africa, U.S.A.
107. <i>F. vaillantii</i> Loisel. In Desv. J. Bot. 2: 358. 1809.	: India, Pakistan, Nepal, Europe, N. America.
108. <i>Glaucium elegans</i> Fisch. and Mey., Ind. Sem Hort. Petrop. 1:29. 1835.	: Pakistan, Iran, Afghanistan, Armenia, Azerbaijan, Turkmenistan, Russia, Kyrgyzstan, Tajikistan.
109. <i>G. fimbriigerum</i> (Trautv.) Boiss., Fl. Orient 1:120. 1867.	: Pakistan, Afghanistan, Iran, Turkmenistan.
110. <i>Hypecoum leptocarpum</i> Hook. f. and Thoms. Fl. Ind. 1: 276. 1855.	: India, Nepal, Bhutan, China, Magnolia, Japan, Afghanistan, Russia, Turkmenistan.
111. <i>H. pendulum</i> L., Sp. Pl. 124. 1753. var. <i>peuchulum</i>	: India, Pakistan, W. Asia, Europe, Turkmenistan, Iran, Turkey.
112. <i>H. pendulum</i> L., var. <i>parviflorum</i> (Karelin and Kir.) Cullen in Rech. F., Fl. Iran, 34: 25. 1966.	: India, Pakistan, Afghanistan, Iran, Turkey, Russia, Turkmenistan.
113. <i>Meconopsis aculeata</i> Royle, Illus. Bot. Himal. 67. 1834.	: India, Pakistan, China.
114. <i>M. bella</i> Prain in J. Asiat. Soc. Bengal 63(2): 82. 1894.	: India, Nepal, Bhutan.
115. <i>M. betonicifolia</i> Franchet, Pl. Delav. I: 42. 1889.	: India, Myanmar, China.
116. <i>M. concinna</i> Prain, Bull. Misc. Inform. Kew 1915. 163. 1915.	: Bhutan, China.
117. <i>M. dhwojii</i> G. Taylor ex Hay, New Fl. and Silva 4:225.1932.	: Nepal.
118. <i>M. discigera</i> Prain in Ann. Bot. 20: 356.1906.	: India, Nepal, Bhutan, China.
119. <i>M. eximia</i> Prain, Bull. Misc. Inform. Kew 1915: 159. 1915.	: Myanmar, China.
120. <i>M. gracilipes</i> G. Taylor in Gard. Chron. 92: 38. 1932.	: Nepal, Myanmar, China.
121. <i>M. grandis</i> Prain in J. Asiat. Soc. Bengal 64(2) 320.1895.	: India, Nepal, Bhutan, Myanmar, China.
122. <i>M. horridula</i> Hook. f. and Thoms. Fl. Ind. 1: 252. 1855.	: India, Nepal, Bhutan, China, Japan.
123. <i>M. integrifolia</i> (Maxim.) Franchet, Bull. Soc. Bot. France 33: 89.1886. var. <i>integrifolia</i>	: Myanmar, China.
124. <i>M. impedita</i> Prain, Bull. Misc. Inform. Kew 1915: 162. 1915.	: Myanmar, China.
125. <i>M. lancifolia</i> (Franchet) Franchet ex Prain, J. Asiat. Soc. Bengal, Pt.2, Nat. Hist. 64: 311. 1896.	: Myanmar, China.
126. <i>M. latifolia</i> (Prain) Prain in Bull. Misc. Inf. kew 1915: 146. 1915.	: India.
127. <i>M. lyrata</i> (Prain) Prain in Bull. Misc. Inf. Kew 1915: 142. 1915.	: India, Nepal, Bhutan, China.
128. <i>M. napaulensis</i> de Candolle, Prodr. 1: 121.1824.	: India, Nepal, China.
129. <i>M. neglecta</i> G. Taylor, Acc. Meconopsis 102.1934.	: India, Pakistan.
130. <i>M. paniculata</i> Prain in J. Asiat. Soc. Bengal 64(2): 316. 1896.	: India, Nepal, Bhutan, China.
131. <i>M. pratii</i> (Prain) Prain, Bot.Mag. 140: sub. T. 8568. 1914.	: India, Nepal, Bhutan, Myanmar, China, Japan.
132. <i>M. primuliana</i> Prain in J. Asiat. Soc. Bengal 64(2): 319. 1896.	: Bhutan, China.
133. <i>M. regia</i> G. Taylor in Journ. Bot. 67: 259. 1929.	: Nepal.
134. <i>M. robusta</i> Hook. f. and Thoms., Fl. Ind. 253. 1855.	: India.
135. <i>M. rubra</i> F. K. Ward in Gard. Chron. 82: 506. 1927.	: Myanmar.
136. <i>M. sherriffii</i> Taylor in New Flora and Silva. 9: 155. 1937.	: Bhutan.
137. <i>M. simplicifolia</i> (D. Don) Walpers, Repert. Bot. Syst. 1 110. 1842.	: India, Nepal, Bhutan, China.
138. <i>M. sinuata</i> Prain in J. Asiat. Soc. Bengal 64(2): 314. 1896.	: India, Nepal, Bhutan.
139. <i>M. smithiana</i> (Handel-Mazzetti) G. Taylor ex Handel-Mazzetti, Symb. Sin. 7: 337.1931.	: Myanmar, China.
140. <i>M. superba</i> Prain in J. Asiat. Soc. Bengal 64(2): 317. 1896.	: India, Bhutan, Myanmar, China.
141. <i>M. taylorii</i> L. H. J. Williams in Trans. Bot. Soc. Edinburgh, 41: 348. 1972.	: Nepal.
142. <i>M. villosa</i> (Hook. f.) G. Taylor, Acc. Meconopsis 28. 1934.	: India, Nepal, Bhutan.
143. <i>M. violacea</i> , F. K. Ward in Gard. Chron. 82: 150. 1927.	: Myanmar, China.
144. <i>M. wallichii</i> Hook. Bot. Mag. 78: t.4668.1852.	: India, Nepal, Bhutan, China.
145. <i>Papaver decaisnei</i> Hochst. and Steud. ex Elkan, Tent. Monog. Papv. 26. 1854.	: Pakistan, Iraq, Iran, Afghanistan, Jordan, Israel.
146. <i>P. dubium</i> L. Sp. Pl. 1196. 1753. 1994.	: India, Pakistan, Nepal, Afghanistan, Iran, W. Asia, N. Africa, Micronesia, Europe.
147. <i>P. hybridum</i> I. Sp. Pl. 506. 1753.	: India, Pakistan, Afghanistan, West Asia, North Africa, Europe.
148. <i>P. macrostomum</i> Boiss., Fl. Orient. 1: 115. 1867.	: India, Pakistan, Afghanistan, Iraq, Iran, Turkey, Russia, Georgia, Armenia.
149. <i>P. nudicaule</i> L., Sp. Pl. 507. 1753 var. <i>nudicaule</i>	: India, Pakistan, Afghanistan, Russia, Mongolia, China, N and C. Asia.
150. <i>P. pavoninum</i> Mey. in Fisch., Ind. Sem. Hort. Petrop. ix.: 82 1843. ssp. <i>pavonium</i>	: Pakistan, China, Turkmenistan, Kazakhstan, Tajikistan, Uzbekistan, Iran, Afghanistan.
151. <i>P. rhoeas</i> L., Sp. Pl. 507. 1753. var. <i>rhoeas</i> .	: India, Pakistan, Nepal, Bhutan, China, W. Asia, Europe, North Africa.
152. <i>P. somniferum</i> L., Sp. Pl. 1: 508. 1753. var. <i>somniferum</i>	: India, Pakistan, Nepal, Bhutan, Myanmar, Laos, Thailand, China, Afghanistan, Europe, C. Asia and widely cultivated.
153. <i>P. stewartianum</i> Jafri and Qaiser in Fl. W. Pakistan, 61: 13. 1974.	: Pakistan.
154. <i>Roemeria hybrida</i> (Linn) DC. Syst. Nat. ii: 93. 1821.	: Pakistan, China, Turkey, Russia, France, Egypt, Iran, Jordan, Afghanistan North Africa, C. and S.W. Asia, C. Europe.
155. <i>R. refracta</i> DC., Syst. Nat. ii: 93. 1821.	: Pakistan, China, Iran, Turkey, Afghanistan, Armenia, Azerbaijan, Kazakhstan, Russia, Tajikistan, Turkmenistan, Uzbekistan, S.W. Asia.

Table 2: The checklist of endemic taxa of Papaveraceae in India

Name of taxa	Phytogeographic zones of India																	
	P-1	P-2	P-3	P-4	P-5	P-6	P-7	P-8	P-9	P-10	P-11	P-12	P-13	P-14	P-15	P-16	P-17	P-18
<i>Corydalis boweri</i> Hemsley.	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Corydalis changuensis</i> D.Long	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Corydalis duthiei</i> Maxim.	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Dicentra ventii</i> Khanh	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Meconopsis latifolia</i> (Prain) Prain	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Meconopsis robusta</i> Hook. f. and Thoms.	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

+: Presence, -: Absence, Phytocorial Divisions: North-West Himalayas (P-1), Western Himalayas (P-2), Central Himalayas (P-3), Eastern Himalayas (P-4), North East India (P-5), Indian Desert (P-6), Semi Arid Region (P-7), Gangetic plain (P-8), Central Deccan plateau (P-9), Northern Eastern Ghat (P-10), Southern Eastern Ghat (P-11), North Western Ghat (P-12), Central Western Ghat (P-13), Southern Western Ghat (P-14), Coromandel Coast (P-15), Malabar Coast (P-16), Andaman and Nicobar Islands (P-17), Laccadive and Minicoy Is. (P-18) (Kundu, 2001)

Table 3: Phytogeographical distribution of endemic taxa of Papaveraceae in India

Phytogeographical regions	Genera	Species
P-1	<i>Meconopsis</i>	1
P-2	<i>Corydalis</i> , <i>Meconopsis</i>	2
P-1, P-2	<i>Corydalis</i>	1
P-3	<i>Corydalis</i> , <i>Dicentra</i>	2

Table 4: Species composition and representation of endemic taxa of Papaveraceae in India

Genera	Total taxa in India	Endemics		Total endemic taxa	%
		Species	Sub species		
<i>Corydalis</i>	63	3	0	3	4.76
<i>Dicentra</i>	4	1	0	1	25.00
<i>Meconopsis</i>	18	2	0	2	11.11

Endemism of Papaveraceae in India: Analysis on species distribution of Papaveraceae revealed that there are six taxa restricted in distribution in Indian territory (Table 2). From Table 2, it has been found that out of six taxa, there are three taxa belonging to *Corydalis* sp. two taxa belong to *Meconopsis* sp. and one taxon belongs to *Dicentra* sp. Out of these six taxa, one is confined in N. W. Himalayas (P-1) and two taxa are restricted to Western Himalayan (P-2) regions, 2 taxa are confined in (P-3) Central Himalayas and the rest one is extended From N.W. to W. Himalayas (P-1, P-2). Distribution of six endemic taxa of Papaveraceae in different phytographical region is shown in Table 3.

From the Table 3, it is very difficult to designate any particular matrix as endemic matrix of Papaveraceae in India. But, it is clear that the endemic taxa, belonging to Papaveraceae, are confined in Himalayan region, only. However, species composition and representation of endemic taxa, belonging to Papaveraceae in India, is presented in Table 4.

Among the three genera, *Corydalis* is represented with higher number of 3 endemic taxa with 4.76% endemism, followed by *Meconopsis* with 11.11% having 2 taxa, whereas *Dicentra* shows highest degree of endemism i.e., 25% with ca. 1 taxon only. It has been found that *C. cavei*, D. Long. flowers for a long time from May-October, but other two *Corydalis* spp. flushes for a short span (August-September) but rest of the three endemic taxa belonging to *Dicentra* and *Meconopsis*

flowers from July- October. It is also found that *Dicentra ventii* Khanh occurs in the altitude of 1500-2700 m altitudinal range but *Corydalis boweri* Hemsley, *C. changuensis* D. Long, *C. duthiei* Maxim, occur in greater altitudinal range from 2700-4300 m and two species of *Meconopsis* genus: *Meconopsis latifolia* (Prain) Prain and *M. robusta* Hook.f and Thoms. occur in the intermediate altitudinal range between 2400-4000 m.

Endemism of Papaveraceae in Indian subcontinent: In the Broader aspect, extent of endemism of Papaveraceae in Indian subcontinent is tabulated in Table 5.

From Table 5, it has been found that there are ca.44 taxa, confined in Indian subcontinent. Out of ca.44 taxa, eight taxa are confined in Indo-Pakistan region (i.e., N. W. Himalayan regions), two taxa are confined in Indo-Pakistan-Nepal (Northwestern-Western Himalayan regions), nine taxa are confined in Indo-Bhutan region (Central Himalayan regions), fourteen taxa are confined in Indo-Nepal region (Western Himalayan regions), six taxa are confined in Indo-Nepal-Bhutan (Central-Western Himalayan regions) region, two taxa are spatially distributed over Indo-Nepal-Myanmar region (Western Himalayas-gateway of South East Asian regions) and rest of the two taxa are confined in Indo-Mayanmar region (i.e., Gateway of Southeast Asian regions). In the broader aspect, those taxa, which are found to be restricted distribution in Indian subcontinent, should be treated as Broad Range Endemics or B.R.E. (Kundu, 2005). From the distributional pattern of B.R.E., it has been found that Western and Central Himalayan region is the congenial abode for endemic taxa of Papaveraceae in Indian subcontinent (Fig. 1), on the other hand the strictly confined six taxa in Indian territory, should normally be treated as Narrow Range Endemics or N.R.E. (Kundu, 2005), distributed in Northwestern Himalayas and Western Himalayas, respectively. Comprising N.R.E.s and B.R.E.s there are 50 taxa restricted (Endemic) in India subcontinent (E.I.S.) and out of 50 taxa, 33 are restricted in Central and Western Himalayas, which helps to identify the are as Ideal resort for endemic taxa belonging to Papaveraceae s.l.

Table 5: The checklist of endemic taxa of Papaveraceae in Indian subcontinent

Name of taxa	India	Pakistan	Nepal	Bhutan	Bangladesh	Myanmar	Sri Lanka	Alt. (m)	Fl. Time
<i>Corydalis adjatifolia</i> var. <i>heterocarpa</i> Jafri	+	+	-	-	-	-	-	3000-3100	June-Aug.
<i>Corydalis alburyi</i> Ludlow and Stearn	-	-	-	-	-	-	-	5000	#
<i>Corydalis aurantiaca</i> Ludlow and Stearn	-	-	-	+	-	-	-	4500-4700	June-July
<i>Corydalis brevicaricata</i> Ludlow	+	-	+	-	-	-	-	3700	#
<i>Corydalis calliantha</i> Long.	-	-	-	+	-	-	-	3800-4730	June-Oct.
<i>Corydalis chaerophylla</i> Dc.	+	-	+	+	-	-	-	2100-4200	May-Nov.
<i>Corydalis chasmophila</i> Ludlow and Stearn	-	-	+	+	-	-	-	#	#
<i>Corydalis clavibracteata</i> Ludlow and Stearn	-	-	+	-	-	-	-	3660-4700	#
<i>Corydalis crispa</i> Prain	+	-	-	+	-	-	-	3500-4600	July-Sept
<i>Corydalis denticulato-bracteata</i> Fedde	-	-	-	-	-	-	-	4880	Aug.
<i>Corydalis drepanantha</i> D. Long.	+	-	-	+	-	-	-	2000-2300	Apr-July
<i>Corydalis dubia</i> Prain	+	-	-	+	-	-	-	3800-4800	July-Sept.
<i>Corydalis elegans</i> Hook.f. and Thoms.	+	-	+	-	-	-	-	3600-4600	July-Aug
<i>Corydalis filicina</i> Prain	+	+	-	-	-	-	-	3000-4500	Apr-Sept.
<i>Corydalis filiformis</i> Royle	+	+	-	-	-	-	-	2500-4000	June-Aug.
<i>Corydalis gerdae</i> Fedde	-	-	+	+	-	-	-	4400-4900	July-Sept.
<i>Corydalis geraniifolia</i> Hook. f. and Thoms.	+	+	+	-	-	-	-	2400-3350	Aug-Nov.
<i>Corydalis iochanensis</i> Leville	-	-	-	+	-	-	-	2500-3500	May-June
<i>Corydalis lathyroides</i> Prain	+	-	-	+	-	-	-	3000-4100	July-Aug.
<i>Corydalis megacalyx</i> Ludlow and Stearn	-	-	+	-	-	-	-	3600-4500	#
<i>Corydalis mitae</i> Kitamura	-	-	+	-	-	-	-	#	#
<i>Corydalis murreeana</i> Jafri	-	+	-	-	-	-	-	#	#
<i>Corydalis nepalensis</i> Kitamura	-	-	+	-	-	-	-	#	#
<i>Corydalis nana</i> Royle	+	-	+	-	-	-	-	4200-6000	July-Aug
<i>Corydalis oxalidifolia</i> Ludlow and Stearn	-	-	+	-	-	-	-	4250-4570	June-Aug.
<i>Corydalis pakistanica</i> Jafri	+	+	-	-	-	-	-	4000-5500	May-Aug.
<i>Corydalis saltatoria</i> W. W. Smith	-	-	-	-	-	+	-	#	#
<i>Corydalis shakya</i> Liden	+	-	+	-	-	-	-	3600-3900	July-Aug.
<i>Corydalis staintonii</i> Ludlow and Stearn	-	-	+	-	-	-	-	3100-4800	#
<i>Corydalis stewartii</i> Fedde	+	+	-	-	-	-	-	2800-3800	May-Sept.
<i>Corydalis thyrsoflora</i> Prain	+	+	-	-	-	-	-	3500-5000	June-Sept.
<i>Corydalis sykesii</i> Ludlow and Stearn	-	-	+	-	-	-	-	4250	#
<i>Dicentra macropous</i> Prain	+	-	+	-	-	+	-	#	Jan-Dec.
<i>Dicentra paucinervia</i> K. Stern	-	-	+	-	-	+	-	900-1500	May-Nov.
<i>Meconopsis bella</i> Prain	+	-	+	+	-	-	-	3700-4800	June-Oct.
<i>Meconopsis dhwoajii</i> G. Taylor	-	-	+	-	-	-	-	3500-5600	#
<i>Meconopsis neglecta</i> G. Taylor	+	+	-	-	-	-	-	3350-4000	#
<i>Meconopsis regia</i> G. Talor	-	-	+	-	-	-	-	3500-4600	#
<i>Meconopsis sherriffii</i> G. Taylor	-	-	-	+	-	-	-	4200-4600	June-July
<i>Meconopsis sinuata</i> Prain	+	-	+	+	-	-	-	3600-4500	July-Oct.
<i>Meconopsis rubra</i> F. K. Ward.	-	-	-	-	-	+	-	#	#
<i>Meconopsis taylorii</i> L. H. J. Williams	-	-	+	-	-	-	-	3600-4500	#
<i>Meconopsis villosa</i> (Hook. f.) G. Taylor	+	-	+	+	-	-	-	2700-4200	May-Sept.
<i>Papaver stewartianum</i> Jafri and Qaiser	-	+	-	-	-	-	-	#	April

+: Presence, -: Absence, #: Data is not available

It has been found that the total number of taxa belonging to Papaveraceae on the Indian subcontinent is 155; whereas the total number of taxa in India is 103 (66.45%). The number of endemic taxa in Indian subcontinent is not so impressive: 50 (32.25%). The number of Narrow Range Endemics is 6 (3.87%) and the number of Broad Range Endemics is 44 (28.38%). From the retrospective viewpoint of species dynamics, the percentage of endemism of Papaveraceae on Indian subcontinent in 1939-1940 (Chatterjee, 1939) was 65.11%, whereas in 2004-2006, it has become 32.25%. The negative index of phytoendemism could be defined as either decreasing number of endemic taxa or further expansion of distributional area of endemic taxa or combination of both.

Threatened taxa, belonging to the family Papaveraceae in

India: From the viewpoint of fiscal evaluation of natural resources, the increasing rate of phytoendemism is an important index for national economy of any developing state but shrinkage of a particular germplasm due to habitat destruction and anthropogenic interference is a key negative gradient from conservation as well as economic viewpoint. If the potential resource is underexploited the loss is irreversible the nation as the diminishing resource disappears forever with its unknown potential without further contributing to human being. Though *Argemone mexicana* var. *mexicana* is neither threatened nor endemic but it would be considered as underexploited plant resource which has recently been found having antibacterial properties against Gram

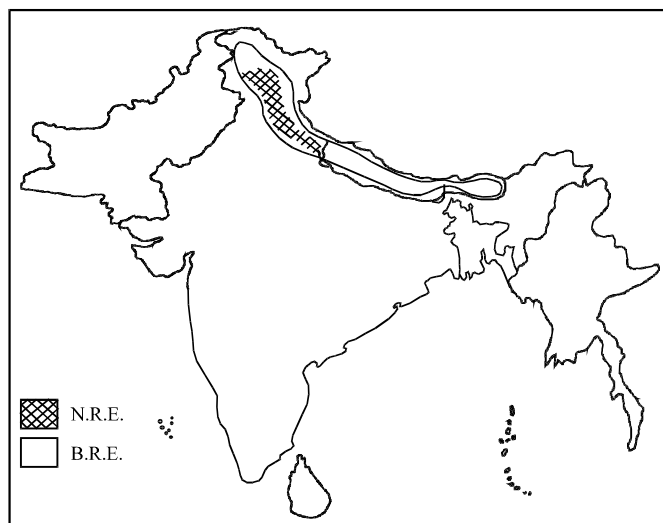


Fig. 1: An outline of endemism of Papaveraceae in Indian subcontinent

Table 6: Plants facing survival threat belonging to the family Papaveraceae in India

Name of taxa	Frequency index	Biotic pressure	Parts used	Flowering season	Altitude (m)
<i>Dicranostigma lactucides</i> Hook. f. and Thoms.	I.	Hort.	Fl.	June-Oct	2700-4700
<i>Meconopsis aculeata</i> Royle	E.	Ec. (Narcotics/Hort.)	Root Fl.	July-Oct.	2400-4700
<i>Meconopsis betonicifolia</i> Franchet.	I.	I.S.P./Ec. (Hort.)	#	July-Sept.	3000-4000
<i>Meconopsis latifolia</i> (Prain) Prain.	V.	Hort.	Fl.	July-Oct.	2200-4600
<i>Meconopsis robusta</i> , Hook. f. and Thoms.	I.	#	#	July-Oct.	2400-4000

#: Data is not available, I: Indeterminate, E: Endangered, I.S.P.: Isolated Small Population, Ec: Economic, Hort.: Horticultural (Ornamental), V: Vulnerable, Fl: Flower

positive (*Staphylococcus aureus*, *Bacillus subtilis*) and Gram negative (*Escherichia coli*, *Pseudomonas aeruginosa*) bacteria (Bhattacharjee *et al.*, 2006). The endemics of Papaveraceae and locally confined pan endemics with isolated small patches with less than minimal viable population size are the outfall of habitat disturbance and anthropogenic interference like ethno botanical utilization, conversion of wild habitat to cultivation field, urbanization etc. and over-exploitation of wild germplasm (e.g., *Meconopsis smilacifolia*, *M. grandis*, *M. betonicifolia* found first time in wild habitat between 1880-1886 and germplasm have been successfully introduced in cultivation since end of eighteenth century as ornamental plants) (Chittendon, 1956; Huxley, 1992; Polunin and Stainton, 1984). It is ascertained that there are five taxa of Indian Papaveraceae facing various degree of threats (Table 6), mainly due to anthropogenic exploitation (over-exploited by nurserymen) for its horticultural importance and medicinal potentialities (e.g., *Meconopsis napaulensis*), chiefly used as folklore and ethno medicine for its narcotic properties and poisonous plants (e.g., *Papaver dubium*, *P. nudicaule*, *P. orientale* etc.) (Chittendon, 1956; Chopra *et al.*, 1986; Envis Centre, 2007; Facciola, 1990; Kunkel, 1984; Tanaka, 1976).

Though *Papaver somniferum* var. *somniferum* (widely cultivated species) is not threatened plant belonging to this family in India but economy of Indian subcontinent has been highly influenced by opium trade (psychoactive chemical derivative of this species) since Sixteenth century. There are two major centers of opium production in two opposite side of Indian subcontinent: Golden Triangle (comprising of Myanmar, Laos and Thailand) and Golden Crescent (comprising of Pakistan, Afghanistan and Iran). The US Department of States estimates that the Golden Triangle led world production until 1991, with Myanmar ranking at top and afterwards Golden Crescent took the lead with Afghanistan breaking the previous record in 1999.

Possible fossil evidence in relation to endemics of Papaveraceae in India: The phylogeny of Papaveraceae *s.l.* has suggested that the presence of multistaminate androecium helped to recognize it as primitive family (Murbeck, 1912; Karrer, 1991). The absence of nectariferous stamens and presence of multistaminate stamens indicates towards the pollination pattern done by pollen collecting insects and this feature further strengthen the hypothesis of primitive origin. It is interesting to focus on phylogenetic relationship by

studying the fossil remains of the ancestors of the modern taxa, which are referable to the endemic taxa of the family Papaveraceae *s.l.* now-a-days. The geographical distribution of *Papaver* S.Str. and *Papaver* sect. *Horrida* and *Fumariadeae* tribe *Fumarieae* in both Mediterranean to Central Asian region and in eastern; South Africa suggests that these taxa supposed to be existed in the middle to late Tertiary when drastic aridification allowed an expansion of the distributional range across the equator (Kadereit, 1988a, b; Kadereit *et al.*, 1995). The fossil remnant of Papaveraceae in India has been represented by *Papaveraceae* *pites thalmanii* Biswas, of Lower Eocene period, Tertiary era, found in N. E. India, particularly in Garo Hills, Meghalaya (Biswas, 1962). The fossil taxon has little affinity with the living *Papaver* spp. except *Papaver somniferum* L., which is a panendemic taxon, whereas other *Papaver* species are concentrated in N. W. Himalayan region. Though lack of fossil remnants of *Meconopsis* in Papaveraceae has helped little to establish the relationship between fossil ancestors and living, endemic representative but the existing fossil representatives of other genera belonging to Papaveraceae during Tertiary era doesn't help to predict it as Palaeoendemics whereas the morphological data particularly floral morphology indicates towards primitiveness; which feature refrained us to categorize the endemics as Neoendemics; so categorically it might be considered under Holoendemics as well as Island endemics, confined on Himalayan mountain ranges, the physically island like habitats.

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