

AN OUTLINE OF THE REVISION OF INDIAN ANACARDIACEAE

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A B S T R A C T

The paper is an outline of revision of Indian Anacardiaceae which embraces 23 genera and 59 species. It deals with the historical review and the phylogeny of the family. Cytological, anatomical, palynological characters and economic uses of some members of the family have also been given. An enumeration of all the Indian taxa with their current nomenclatures and distribution has also been appended. The 61 taxa listed in this work include one new species of *Choeospondias* Burtt. & Hill and a new variety of *Nothopogia heyneana* (Hook. f.) Gamble. A list of threatened species on the basis of herbaria records has also been included.

Lindley (1830) established the family Anacardiaceae, the name being conserved against Terebinthaceae of Jussieu (1791) and Spondiaceae of Kunth (1824). Critical studies of the family were made earlier by Marchand (1869) and Engler (1883). Subsequently after intensive study, a Monograph on the genus *Mangifera* Linn. was published by Mukherjee (1949). Recently Ding Hou (1978) has made a detailed study of the Malesian Anacardiaceae.

As regards Indian work on Anacardiaceae, Hooker (1876) recognised 107 species under 22 genera and grouped them under two tribes — (1) Anacardieae and (2) Spondieae. Hooker's (1876) work covered a larger area than the present limits of India, where 59 species under 23 genera are found to occur. In the regional Floras of India, several species have been recorded from various areas (Prain, 1903; Cooke, 1903; Duthie, 1903; Gamble, 1918; Haines, 1921 and Kanjilal *et al.* 1935). As the floristic studies reported above were undertaken about 80 years back and the present boundaries of the country have been changed and several changes have been made in the nomenclature of the taxa, it was considered necessary to

undertake a revision of the Indian Anacardiaceae, especially because it is a family of great economic importance.

The present investigation mainly concerned study of the morphological characters. Palynological study has also been made. Data on cytological and anatomical characters have been collected from published work (Darlington and Wylie, 1945; Mitra, 1981). Morphological descriptions of the taxa have been drawn after a study of about 2000 specimens from different Indian Herbaria such as (CAL., MH, BSA, BSD, BSI, DD, ASSAM and PBL etc.). Some specimens under the genera *Holigarna* Buch.-Ham. ex Roxb., *Buchanania* Sprengl, *Nothopogia* Blume and *Semecarpus* Linn., which are not available in India have been procured on loan from foreign herbaria (such as Kew, British Museum, Edinburgh etc.). As far as possible, photographs of the type sheets were obtained from Kew.

Observation

The list of the genera and species covered in the present revision and the number of specimens examined have been given in the Table.

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After a detailed study, 59 species and 2 infra-specific taxa under 23 genera have been recognised in the present revision which includes India, Nepal and Bhutan. Of these, 24 taxa are endemic to India, which are marked by an asterisk in the Table. Among these, 14 are confined to south India and 2 restricted to Andaman and Nicobar Islands i.e. *Buchanania platyneura* Kurz and *Semecarpus kurzii* Engler. The following 8 taxa

are very limited in distribution and are considered threatened :

1. *Buchanania barberi* Gamble — Kerala.
2. *Holigarna beddomei* Gamble — Karnataka.
3. *Holigarna nigra* Bourd. — Kerala.
4. *Mangifera khasiana* Pierre — Meghalaya.
5. *Nothopegia aureofulva* Beddome — Kerala.
6. *Nothopegia travancorica* Beddome — Tamil Nadu & Kerala.
7. *Rhus khasiana* Hook. f. — Meghalaya.
8. *Semecarpus auriculata* Beddome — Kerala.

Table : *A census of species of Anacardiaceae in India*

Genus	Species	Distribution
1. <i>Anacardium</i> Linn.	(1) <i>A. occidentale</i> Linn. Sp. Pl. 1 : 385. 1753.	India, America.
2. <i>Bouea</i> Meissn.	(2) <i>B. oppositifolia</i> (Roxb.) Meissn. in Walpers Repr. Bot. Syst. 1 : 556. 1842. <i>Mangifera oppositifolia</i> Roxb. Fl. Ind. 2 : 133. 1824.	India (Andaman Island), Bangladesh, Burma, Sri Lanka, Malay-Peninsula, Indonesia and Thailand.
3. <i>Buchanania</i> Spreng.	(3) <i>B. axillaris</i> (Dess.) Ramamoorthy in Saldanha & Nicholson's Fl. Hassan : 374. 1976. <i>Mangifera axillaris</i> Dess. in Lamarck Encycl. Meth. Bot. 3 : 697. 1789.	India, Sri Lanka.
	*(4) <i>B. barberi</i> Gamble in Kew Bull. : 135. 1916.	India (Kerala)—rare.
	(5) <i>B. lanceolata</i> Wight Icon. Pl. Ind. Or. t. 237. 1839 and Illustr. Ind. Bot. 1 : 185. 1839.	India (Kerala), Burma.
	(6) <i>B. lancifolia</i> Roxb. Fl. Ind. 2 : 386. 1832.	India (Andaman Island), Bangladesh, Burma.
	(7) <i>B. lanzan</i> Spreng. Schr. Journ. 4 : 234. 1800.	India, Burma.
	*(8) <i>B. platyneura</i> Kurz Journ. As. Soc. Beng. 45 : 125. 1876.	India (Andaman and Nicobar Islands).
	(9) <i>B. sessilifolia</i> Blume Mus. Bot. Lugd. Bot. 1 : 185. 1849.	India (Andaman and Nicobar Islands, Assam), Malay Peninsula, Indonesia and Thailand.
4. <i>Choerospondias</i> Burtt. & Hill.	*(10) <i>C. auriculata</i> Chandra, D. Journ. Bomb. Nat. Hist. Soc. 75 : 457-460. 1979.	India (Uttar Pradesh).
	*(11) <i>C. axillaris</i> (Roxb.) Burtt. & Hill. Ann. Bot. n.s. 1 : 254. 1937. <i>Spondias axillaris</i> Roxb. Fl. Ind. 2 : 453. 1832.	India, Nepal, Burma, China and Thailand.
5. <i>Cotinus</i> Scop.	(12) <i>C. coggygria</i> Scop. Fl. Carn. ed. 2, 1 : 220. 1772.	India, China.
6. <i>Dracontomelum</i> Blume	(13) <i>D. dao</i> (Blanco) Merr. & Rolfe Philip. Journ. Sc. 3 : 108. 1908; <i>Paliurus dao</i> Blanco Fl. Philip. : 174. 1837.	India (Andaman and Nicobar Islands), Burma, Malay Peninsula Philippine and Fiji Island.

Genus	Species	Distribution
7. <i>Drimycarpus</i> Hook.	(14) <i>D. racemosus</i> (Roxb.) Hook. f. Fl. Brit. Ind. 2 : 36. 1876. <i>Holigarna racemosa</i> Roxb. Fl. Ind. 2 : 82. 1832.	India, Bangladesh, Burma.
8. <i>Gluta</i> Linn.	*(15) <i>G. travancorica</i> Bedd. Fl. Sylv. 1 : t. 60. 1870.	India (Tamil Nadu, Kerala).
9. <i>Holigarna</i> Buch.-Ham. ex Roxb.	*(16) <i>H. arnottiana</i> Hook. f. Fl. Brit. Ind. 2 : 36. 1876.	India.
	*(17) <i>H. beddomei</i> Hook. f. Fl. Brit. Ind. 2 : 38. 1876.	India (Tamil Nadu, Karnataka) —rare.
	*(18) <i>H. ferruginea</i> March. Rev. Anacard.: 171. 1869.	India (Andaman Island, Tamil Nadu, Karnataka & Kerala).
	(19) <i>H. grahamii</i> (Wight) Kurz, Ind. For. 102 : 89. 1876. <i>Semecarpus grahamii</i> Wight Icon. Pl. Ind. Or. t. 235. 1839. Illus. Ind. Bot. 1 : 185. 1839.	India (Andaman Island), Burma.
	(20) <i>H. kurzii</i> King, Journ. As. Soc. Beng. 65 : 512. 1896.	India (Andaman Island, Manipur, Tripura), Burma.
	*(21) <i>H. nigra</i> Bourd. Ind. For. 30 : 95. t. 1. 1904.	India (Kerala) —rare.
10. <i>Lannaea</i> A. Richard	(22) <i>L. coromandelica</i> (Houtt.) Merr. Journ. Arn. Arb. 19 : 353. 1938. <i>Dialium coromandelicum</i> Houtt. Nat. Hist. 2 : 39. t. 5. f. 2. 1774.	India, Nepal, Bangladesh, Burma, Pakistan and Sri Lanka.
11. <i>Mangifera</i> Linn.	*(23) <i>M. andamanica</i> King Journ. As. Soc. Beng. 65 : 470. 1896.	India (Assam and Andaman Island).
	(24) <i>M. indica</i> Linn. Sp. Pl. 1 : 200. 1753.	India.
	*(25) <i>M. khasiana</i> Pierre Fl. for Cochin. t. 364.c 1897.	India (Meghalaya)—rare.
	*(26) <i>M. sylvatica</i> Roxb. Fl. Ind. 2 : 438. 1824.	India (Andaman Island and Assam) —rare.
12. <i>Melanorrhoea</i> Wall.	(27) <i>M. usitata</i> Wall. Pl. As. Rar. 1 : 9. t. 11 & 12. 1829.	India (Manipur), Burma.
13. <i>Nothopegia</i> Blume	*(28) <i>N. aureofulva</i> Bedd. ex Hook. f. Fl. Brit. Ind. 2 : 40. 1876.	India (Kerala)—rare.
	*(29) <i>N. beddomei</i> Gamble Fl. Pres. Madr. 1(1): 189. 1918.	India (Tamil Nadu).
	<i>N. beddomei</i> Gamble var. <i>wynaadica</i> Ellis & Chandrasekharan Bull. bot. Surv. Ind. 12(2): 257. 1970.	India (Kerala, Tamil Nadu).
	*(30) <i>N. colebrookiana</i> (Wight) Blume Mus. Bot. Lugd. Bat. 1 : 203. 1849.	India (Tamil Nadu).
	*(31) <i>N. heyneana</i> (Hook. f.) Gamble Fl. Pres. Madr. 1(1): 189. 1918.	India (Andhra Pradesh, Tamil Nadu, Kerala).
	<i>N. heyneana</i> (Hook. f.) Gamble var. <i>linearifolia</i> Chandra, D. & Ghosh, R. B. Bangladesh Journ. Bot. 9: 173-175. 1980.	Tamil Nadu.

Genus	Species	Distribution
	*(32) <i>N. racemosa</i> (Dalz.) Ramamoorthy in Saldanha and Nicholson Fl. Hassan Dist.: 377. 1976. <i>Glycecarpus racemosus</i> Dalz. Journ. As. Soc. Beng. 3: 69. 1849.	India (Tamil Nadu).
	*(33) <i>N. travancorica</i> Bedd. ex Hook. f. Fl. Brit. Ind. 12: 40. 1876.	India (Tamil Nadu, Kerala).
14. <i>Parishia</i> Hook. f.	(34) <i>P. insignis</i> Hook. f. Trans. Linn. Soc. 23: 169. t. 26. 1860.	India (Andaman Island), Burma, Malay Peninsula.
15. <i>Pegia</i> Colebr.	(35) <i>P. nitida</i> Colebr. Trans. Linn. Soc. 15: 364. 1827.	India, Bangladesh, Burma, China and Philippines.
16. <i>Pistacia</i> Linn.	(36) <i>P. integerrima</i> Stewart in Brandis For. Fl.: 122. t. 22. 1874.	India (Himachal Pradesh, Uttar Pradesh, Arunachal Pradesh), Pakistan.
	(37) <i>P. khinjak</i> Stocks Hook. Kew Journ. 4: 143. 1852.	India (Himachal Pradesh, Uttar Pradesh and Arunachal Pradesh), Pakistan.
17. <i>Rhus</i> Linn.	(38) <i>R. griffithii</i> Hook. f. Fl. Brit. Ind. 2: 12. 1876.	India, Burma.
	(39) <i>R. hookeri</i> Bahadur & Sahani Ind. For. 96: 769. 1970. <i>R. insignis</i> Hook. f. Fl. Brit. Ind. 2: 1876.	India, Nepal.
	*(40) <i>R. kanaka</i> De, R. N. Ind. For. 68: 65. 1942.	India (Meghalaya)—rare.
	*(41) <i>R. khasiana</i> Hook. f. Fl. Brit. Ind. 2: 10. 1876.	India (Meghalaya)—rare.
	*(42) <i>R. paniculata</i> Wall. ex Don Gen. Syst. 2: 74. 1832.	India.
	(43) <i>R. punjabensis</i> Stewart in Brandis For. Fl. 120. 1874.	India, Tibet, Burma and Pakistan.
	(44) <i>R. semialata</i> Murray Comm. Soc. Goett. 5: 27. t. 3. 1784.	India, China and Japan.
	(45) <i>R. sinuata</i> Thunb. Prodr. Fl. Capen.: 52. 1794. <i>R. mysorensis</i> Don Gen. Syst. 2: 74. 1832.	India, Burma, Pakistan and Africa.
	(46) <i>R. succedanea</i> Linn. Mant. Pl. 2: 221. 1771.	India, China.
	(47) <i>R. tomentosus</i> Linn. Sp. Pl. 1: 266. 1753.	India (Tamil Nadu), Africa
	(48) <i>R. wallichii</i> Hook. f. Fl. Brit. Ind. 2: 11. 1876.	India, Nepal, Burma and Pakistan.
18. <i>Schinus</i> Linn.	(49) <i>S. terebinthifolius</i> Raddi Mam. Mod. 18. Fis. 399. 1820.	India (cultivated), America, Australia and Brazil.
19. <i>Searsia</i> Barkley	(50) <i>S. parviflora</i> (Roxb.) Barkley in Lilloa, 23: 252; 1950. <i>Rhus parviflora</i> Roxb. Fl. Ind. 2: 100. 1832.	India, Nepal.

Genus	Species	Distribution
20. <i>Semecarpus</i> Linn. f.	(51) <i>S. anacardium</i> Linn. f. Suppl. Pl.: 285. 1781.	India, Australia.
	*(52) <i>S. auriculata</i> Bedd. Fl. Sylv. 2: t. 231. 1870.	India (Tamil Nadu, Kerala)—rare.
	*(53) <i>S. kurzii</i> Engl. in DC. Mon. Phan. 4: 478. 1883.	India (Andaman and Nicobar Islands).
	(54) <i>S. prainii</i> King., Journ. As. Soc. Beng. 65: 511. 1896.	India (Andaman Island, Assam), Bangladesh.
	(55) <i>S. subpanduriformis</i> Wall. ex Hook. f. Fl. Brit. Ind. 2: 35. 1876.	India (Andaman and Nicobar Islands), Bangladesh and Burma.
	*(56) <i>S. travancorica</i> Bedd. Fl. Sylv. 2: t. 232. 1870.	India (Kerala)—rare.
21. <i>Solenocarpus</i> Wight	*(57) <i>S. indica</i> Wight & Arnott. Prodr. Fl. Penin. Ind. Or. 1: 172. 1834.	India (Kerala).
22. <i>Spondias</i> Linn.	(58) <i>S. pinnata</i> (Linn. f.) Kurz Prel. Rep. For. & Veg. Pegu, Append. A 44: A PP. B. 42. 1875. <i>Mangifera pinnata</i> Linn. f. Suppl. Pl.: 156. 1781.	India, Burma.
23. <i>Swintonia</i> Griffith	(59) <i>S. floribunda</i> Griffith Proc. Linn. Soc. 1: 283. 1849.	India (Mizorum), Bangladesh, Burma, Malay Peninsula.

*indicates endemic species.

KEY TO THE INDIAN GENERA OF ANACARDIACEAE

1. Carpels free or only one. Leaves simple, entire ... Tribe *Mangiferae*
2. Carpels usually 5, free, only one fertile. Drupe more or less lenticular ... *Buchanania*
3. Leaves opposite ... *Bouea*
- 3a. Leaves alternate;
4. Fruit a fleshy drupe. Single stamen fertile, rest sterile ... *Mangifera*
- 4a. Fruit a reniform nut on a fleshy hypocarp. Single stamen sterile, rest fertile ... *Anacardium*
5. Petals deciduous not enlarging in fruits ... *Gluta*
- 5a. Petals accrescent, enlarged in fruits—
6. Gynophore present. Drupe stipitate ... *Melanorrhoea*
- 6a. Gynophore absent. Drupe sessile ... *Swintonia*
- 1a. Carpels united, (rarely only 1). Leaves rarely simple—
7. Carpels usually 5, ovary 5-(rarely 1) celled ... Tribe *Spondieae*
8. Fruit 5-celled; styles 5—
9. Styles connate at tip ... *Dracontomelum*
- 9a. Styles free above—
10. Mesocarp fibrous, endocarp not stony. Leaves with sub-marginal vein ... *Spondias*
- 10a. Mesocarp not fibrous, endocarp stony. Leaves without sub-marginal vein ... *Chaerospondias*
- 8a. Fruit 1-celled; style 1—
11. Shrub, not climbing ... *Solenocarpus*
- 11a. Shrub, climbing ... *Pegia*
- 7a. Carpels 3, ovary 1-celled—
12. Ovary inferior/semi-inferior. Fruit sunken in a cupular/tubular hollow receptacle. Leaves simple ... Tribe *Semecarpeae*
13. Drupe enclosed within enlarged, fleshy peduncle—
14. Styles 3, petals valvate ... *Holigarna*
- 14a. Style 1, petals imbricate ... *Drimycarpus*
- 13a. Drupe not enclosed but set on a much enlarged apex of peduncle ... *Semecarpus*

- | | | |
|---|-----|-------------------|
| 12a. Ovary superior. Fruit without fleshy peduncle. Leaves both simple and compound | ... | Tribe Rhoideae |
| 15. Flowers haploclamydeous or naked | .. | <i>Pistacia</i> |
| 15a. Flowers dichlamydeous— | | |
| 16. Flowers tetramerous— | | |
| 17. Calyx accrescent. Drupe globose | | <i>Parishia</i> |
| 17a. Calyx not accrescent. Drupe laterally compressed— | | |
| 18. Leaves compound. Stamens 8-10 | | <i>Lannea</i> |
| 18a. Leaves simple. Stamens 4 | .. | <i>Nothopogia</i> |
| 16a. Flowers pentamerous— | | |
| 19. Pedicels of flowers plumose; style lateral, simple | | <i>Cotinus</i> |
| 19a. Pedicels of flowers not plumose; style terminal 3— | | |
| 20. Epicarp hairy, dehiscent. Leaves pinnate compound | | <i>Rhus</i> |
| 20a. Epicarp glabrous, indehiscent | | <i>Searsia</i> |

PHYLOGENY OF THE FAMILY ANACARDIACEAE

On the basis of the morphological characters and other evidences, it is possible at least to group the genera in their natural affinities and indicate the primitive and more recent genera.

The floral morphology of *Buchanania* shows the most primitive features, because it possesses pentamerous flowers with apocarpous pistils, simple, alternate thickly coriaceous leaves. Two other genera namely, *Gluta* and *Melanorrhoea* also exhibit primitive features due to presence of gynophore and all (more than 5) fertile stamens. But they are somewhat advanced in their carpel character, which is monocarpellate. Among other members under monocarpellate group *Bouea* is more primitive than *Swintonia*, *Drimycarpus*, *Anacardium* and *Mangifera*. Among these *Swintonia* possesses 5, fertile stamens with compound, imparipinnate leaves which is an advanced character. Between *Anacardium* and *Mangifera*, the degree of sterility is greater in the latter while in *Drimycarpus* the drupe is found to be enclosed within the hypocarp which is an advanced feature. Among the syncarpous group, the 5-carpellate condition is more primitive than the 3-carpellate one. The former group comprises of a number of genera, among whom *Spondias*, *Dracontome- lum* and *Pegia* (= *Tapiria*) possess 5-styles while *Schinus*, *Solenocarpus* and *Chaerospon- dias* have single style. The members under this group also show some advanced characters individually. The unisexual flowers of

Chaerospondias indicate an advanced character over bisexual flower of others. The climbing, shrubby habit of *Pegia* also exhibits advanced feature over tree habit of other members. Gradually the group arises having 3-carpellate (Syncarpous) condition. Here also 3-fid styles (or stigmas) in terminal position of *Rhus* and *Searsia* are considered to be earlier than single, lateral style of the genus *Cotinus*. Though hypogynae is predominant in Anacardiaceae, but a few genera are characterised by perigynous to epigynous condition. In *Semecarpus* and *Holigarna*, the ovary is semi-inferior showing a gradual evolution. The lower number of floral members is considered as advanced. Hence the tetramerous flowers in *Parishia*, *Lannea* and *Nothopogia* are more recent in origin than pentamerous condition. Petaloid flowers are more primitive than the apetalous (naked type) ones, as found in the single genus *Pistacia*, a climax situation.

The family shows a heteromerous assemblage. The primitive characters i.e. simple (alternate/opposite) leaves, actinomorphic, bisexual, hypogynous, pentamerous flowers, free, numerous fertile stamens, apocarpous or syncarpous ovary, 5-celled ovary with axile placentation, 5-fid styles, gynophore, dichlamydeous flowers with polypetalous corolla and imbricate aestivation etc. are exhibited by a large number of genera while the advanced features like compound leaves, paniculate inflorescence, tetramerous and apetalous flowers, connate petals, cupular disc, few and sterile stamens, perigynae-epigynae, 1-celled ovary with single ovule, simplification of style and

stigma in syncarpous pistil, nut fruit with enlarged fleshy stalk forming pseudocarp are found within other members of the same family. Though woody habit is predominant within the family, climbers are also found.

On the basis of evidences discussed above, a diagram showing phylogenetic trend among the genera of the family Anacardiaceae has been attempted. (Fig. 1)

The following table shows the diploid somatic number of chromosome in some of the Indian genera.

CHROMOSOME NUMBERS

Name of the genera	Diploid Chromosome No.
1. <i>Anacardium</i> Linn.	2n=24
2. <i>Dracontomelum</i> Blume	2n=36
3. <i>Cotinus</i> Scop.	2n=30
4. <i>Lannaea</i> A. Richard	2n=28, 30
5. <i>Mangifera</i> Linn.	2n=40
6. <i>Pistacia</i> Linn.	2n=24, 28, 30
7. <i>Rhus</i> Linn.	2n=30
8. <i>Schinus</i> Linn.	2n=28, 30
9. <i>Semecarpus</i> Linn. f.	2n=60
10. <i>Spondias</i> Linn.	2n=32.

Anatomical features

Recently Mitra (1981) has made a histotaxonomical study of the tribe Mangiferae which comprises of 65 species under 7 genera. The similarity in wood anatomy brings the members of the genera closer to form a homogeneous group in single tribe. According to Metcalfe and Chalk (1950), the structure of wood tends to be evolutionarily more conservative than the features of external morphology.

From an intensive study by Mitra (1981) it was noted that the tribe is a natural taxon. The species are similar in wood anatomy but differ among themselves in secondary characters, which provides a method for separation of one genus from others. Qualitative and quantitative variations in anatomical characters were found to be distinct. Genus *Mangifera* was found to be different from others for its diverse anatomical nature.

It was revealed that morphological diver-

sity and anatomical variations were fairly correlated.

Inter-relations among taxa as obtained by anatomical study, are likely to indicate a distinct line of phylogeny amongst the members of the tribe. *Melanorrhoea*, *Buchanania* and *Anacardium* are grouped as primitive plants while *Bouea*, *Swintonia* and *Gluta* are grouped as advanced amongst the tribe. While in *Mangifera* the conglomeration of the characters present in both groups, was observed, confirming the suggestion of Mukherjee (1949) from cytological study, comparative anatomy of the tribe Mangiferae has been found to support its classification and position among the family, as made by Barkley (1957) and Airy Shaw (1973).

Palynological evidence : Erdtman (1952) described the pollen morphology of the family Anacardiaceae, as usually 3-colporate, (sometimes 2, less frequently 4-colporate or provided with 3-8 poroid or colpoid apertures); usually medium sized, sphaeroidal-prolates. Sexine generally thicker than the nexine, reticulate, often striate.

From previous reports (Erdtman, 1952) and studies carried out by the present authors it is evident that there is a homogeneity in the pollen-morphology. Most of the pollen-grains are prolate and 3-colporate. But the genus *Dracontomelum* possesses 4-colporate grains, while the grains of *Pistacia* are 4-6 poroid, looking like short colpi. In *Cotinus* and *Rhus*, the grains are prolate, tricolporate, $35-53 \times 30-35 \mu$ with long tapering, sharply defined furrows, each with a large germ-pore, surface finely reticulate (Erdtman 1943; Leis., 1979). In *Pistacia*, the grains are spherical, sometimes slightly oblate, $25-40 \mu$, 4-6 pores, elongated, sometimes look as short colpi. Sometimes granulated. Sexine is trifle thicker than the nexine. Surface per-reticulate, reticulum fine and regular (Horowitz, 1967; Erdtman, 1952).

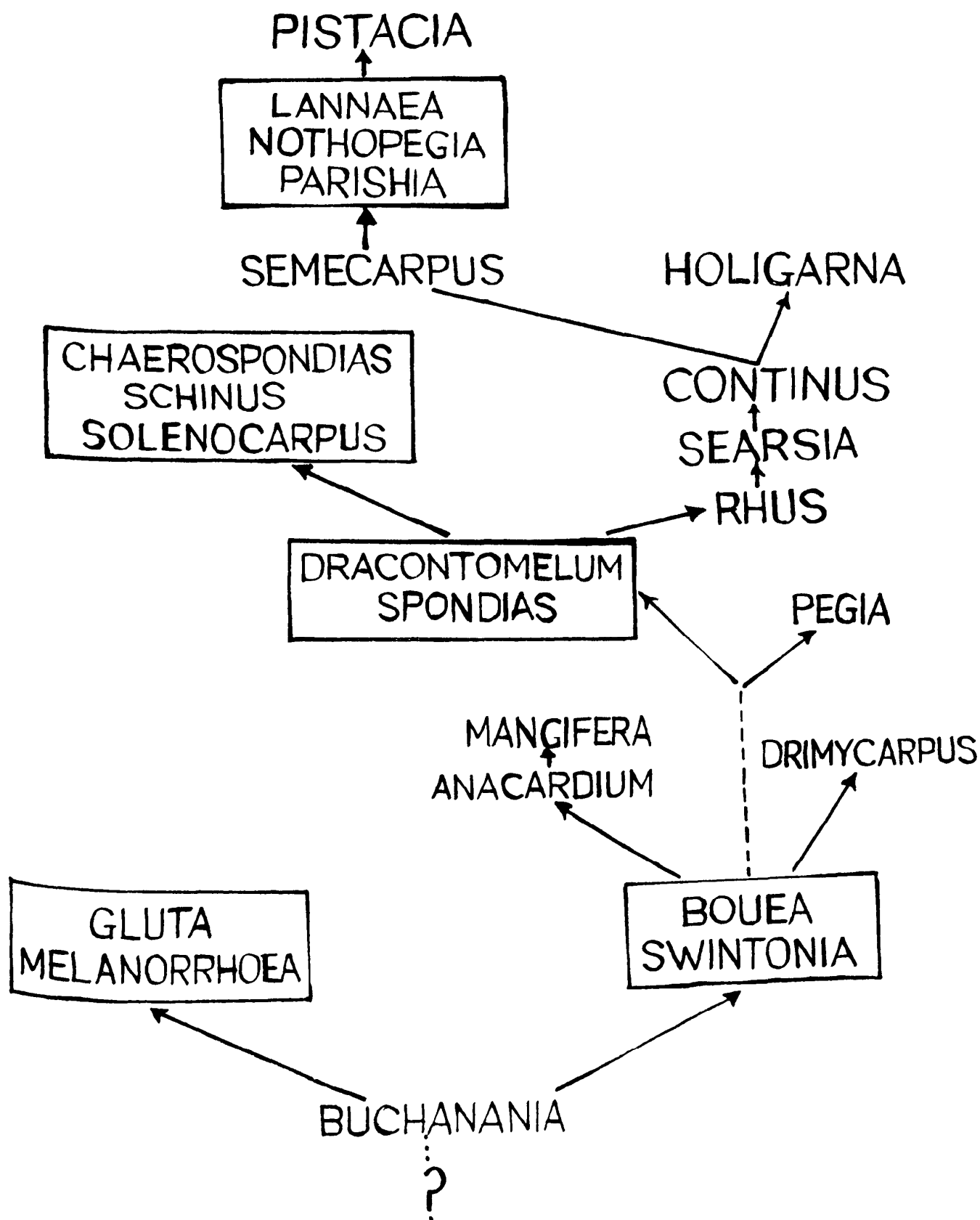


Fig. 1 Tentative Phylogeny in Anacardiaceae

Economic importance

The family is important for the edible fruits, timber, resin, tannin and various other products.

(a) *Fruits*: There are many species, which are economically important for use as edible fruits and to earn foreign exchange. Two important nuts *Pistacia vera* Linn. (Pistacio nut), and *Anacardium occidentale* Linn. (Cashew nut) belong to this family. The juicy receptacle (Cashew apple) is used to prepare squash and wines. The most important fruit of the tropics is the mango (*Mangifera indica* Linn.). More than five hundred grafted cultivars occur in India. It is also used before unripe in curries, conserves, chutneys and pickles. The fruits of *Spondias pinnata* (Kurz) Hook. f. locally known as 'amra' is used in tropics. It has also a sweet cultivar. In Asia, a sweet sour-preserve is prepared from the fruits of *Dracontomelum* like citron.

(b) *Resin-tannin*: The species of *Rhus*, *Cotinus* etc. are important sources for tannin and dye, which are used in tanning leather. Cardol, a black acrid oil obtained from *Anacardium occidentale* Linn. is used to tar boats, preserve fish nets and as an oil or varnish, to preserve household items against insects in the tropics. A substance extracted from the fruits of marking nut tree, *Semecarpus anacardium* Linn. f. is used extensively in India to mark fabrics. Much of the pyrogalllic acid, gallic acid and tannic acid used industrially, are obtained from the nut galls of *Rhus javanica* Linn. A non-poisonous clear tenacious terpentine is obtained from *Pistacia terebinthus* Linn. which was formerly much used in pharmacy.

(c) *Medicine*: The leaves of *Schmaltzia ovata* are used as a remedy for cough and pains of the chest. The fruit decoction of *Rhus typhina* Linn. and *Rhus copallina* Linn. is used in dysmenorrhoea and dysentery. The root decoction is used in haemorrhages and also in urinary troubles. The kernel of

Semecarpus anacardium Linn. f. stimulated memory.

(d) *Timber*: The wood of many members yields important lumber woods. The species under the genera *Mangifera* Linn., *Bouea* Meissn., *Gluta* Hook. f., *Drimycarpus* Hook. f., *Anacardium* Linn. and *Parishia* Hook. f. etc. are very important for producing timber of commerce which is used for various purposes like furniture, beams, slippers, frame-works, match-boxes, etc.

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REFERENCES

- AIRYSHAW, H. K. Dictionary of Flowering Plants and Ferns. Willis, J. C., Revised by Airyshaw, H. K. 7th ed. Cambridge. 1973.
 BARKLEY, F. A. Generic Key to Sumac family (Anacardiaceae). *Lloydia* 20: 258-263. 1957.
 BENTHAM, G. AND J. D. HOOKER. Genera Plantarum 1: 415-428. London. 1862.
 COOKE, T. Flora of the Presidency of Bombay 1: 289-300. London. 1903.
 DARLINGTON, C. D. AND A. P. WYLIE. Chromosome atlas of flowering plants. London. 1945.
 DUTHIE, J. F. Flora of Upper Gangetic Plain 1: 172-178. Calcutta. 1903.
 DE CANDOLLE, A. P. Monographie Phanerogamarum 4: 171-500. Paris. 1883.
 ENGLER, A. IN DE CANDOLLE, A. P. Monographie Phanerogamarum 4: 171-500. Paris. 1882.

- ERDTMAN, G. An Introduction to Pollen Analysis: Waltham, Mass., USA., Chronica Botanica. 65-68. 1943.
- Pollen morphology and Plant Taxonomy in Angiosperms. Stockholm. 1952.
- GAMBLE, J. S. Flora of the Presidency of Madras 1: 183-192. Calcutta. 1918.
- HAINES, H. H. The Botany of Bihar and Orissa 1: 227-263. London. 1921.
- HOOKE, J. D. The Flora of British India 2: 11-44. London. 1876.
- HOROWITZ, A. AND B. BAUN. The Arboreal Pollen Flora of Israel. *Pollen and Spore* 9: 71-93. 1967.
- HOU, DING. *Flora Malesiana*. New Series I. Utrecht Netherlands. 8: 395-548. 1978.
- Flora Malesianae Precursores LVI Anacardiaceae. *Blumea* 24: 1-24. 1978.
- JUSSIEU, A. DE. Genera Plantarum Secundum Ordines Naturales Disposita: Turici Helvitorum, Sumtibus Ziegleri Q. Filliorum. 405. 1791.
- KANJILAL, U. N., A. DAS, P. C. PURAKAYASTHA AND R. N. DE. The Flora of Assam 1: 330-342. Shillong. 1935.
- KUNTH, C. S. *Annals of Science Naturalae* Series I, Part II: 333. 1824.
- LINDLEY, J. Introduction to Natural System of Botany: 127. London. 1830.
- MARCHAND, L. Revision du Groupe des Anacardiaceae. Paris. 1869.
- METCALFE, C. R. AND L. CHALK. Anatomy of the dicotyledons. 1: 452-462. Oxford. 1950.
- MUKHERJEE, S. K. A monograph on the genus *Mangifera* Linn. *Lloydia* 12: 73-136. 1949.
- Mango and its allopolyploid nature. *Nature* 166: 196. 1950.
- PRAIN, D. Bengal Plants 1: 246-252 and 2: 963. London. 1903.
- RALPH, A. I. AND R. A. LEIS. Pollen morphology of Anacardiaceae of N. E. America. *Bull. Torrey Botanical Club* 106: 104-144. 1979.
- WATT, G. Dictionary of the Economic Products of India. Delhi. Rev. Ed. 1972.
- WEALTH OF INDIA — A Dictionary of Indian raw material and Industrial Product. Indian Council of Industrial Research, Delhi. 1948-1976.
- WILLIS, J. C. Dictionary of Flowering Plants and Ferns. Cambridge Univ. Press. 7th Ed. 1973.