J Indian bot Soc Vol 74 (1995) 9-13

FOLIAR ARCHITECTURE OF SAPINDALES OCCURRING AT VISAKHAPATNAM

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(Accepted November 1995)

Foliar architecture including the gross morphology and venation pattern of Sapindales occurring at Visakhapatnam are investigated. The venation patterns recorded are pinnately brochidodromous, craspedodromous and craspedo-brochidodromous. The foliar architecture is found to be taxonomically useful and accordingly a key for identification of the species is provided.

Key Words : Foliar architecture-Sapindales-taxonomy.

Foliar venation of angiosperms has been considered as a good taxonomic character especially when used with other characters. The publications of leaf architecture by Lee (1948), Hickey (1973, 1979), Hickey and Wolfe (1975) have generated interest in a number of workers (Foster, 1950; Varghese, 1966; Melville, 1963, 1976; Kundu, 1974; Sehgal and Paliwal, 1975; Singh *et al.*, 1976; Mohan and Inamdar, 1982; Annamani and Prabhakar, 1991a, 1991b; 1992; Ferzana Jabeen *et al.*, 1991). However meagre information is available on foliar architecture of Sapindales (Rao *et al.*, 1983), which can be used in identification of the pants in absence of flowers. Hence the present investigation deals with the venation patterns of Sapindales occurring at Visakhapatnam, India.

MATERIAL AND METHODS

Mature leaves of nine species viz., *Allophyllus cobbe* (L.) Raeush, *Anacardium occidentale* L., *Buchanania axillaris* (Desr.) Ramamurty, *Cardiospermum halicacabum* L., *Dodonaea viscosa* (L.) Jacq., *Lannea coromandelica* (Houtt.) Merr., *Mangifera indica* L., *Sapindus emarginatus* Vahl., *Semecarpus anacardium* L., belonging to Sapindales available at Visakhapatnam (Venkateswarlu *et al.*, 1972) have been collected personally and preserved in Carnoy's fixative (Johansen, 1940). Ten leaves of each species collected from five different plants were cleared following the usual techniques (Dilcher, 1974). The terms used are after Hickey (1973, 1979), Melville (1976) Prabhakar and Ramayya (1982) and Anna Mani (1992).

OBSERVATIONS AND DISCUSSION

The leaves are simple alternate and symmetrical. They are lanceolate in *Dodonaea viscosa*, elliptic in *Buchanania axillaris*, *Mangifera indica* and *Semecarpus anacardium*, and obovate in *Anacardium occidentale*. They are pinnately compound, unipinnate, paripinnate and leaflets three pairs, subopposite and oblong in *Sapindus emarginatus*, but imparipinnate, leaflets three, terminal leaflet symmetrical elliptic in *Allophyllus cobbe* and leaflets 13, opposite, ovate in *Lannea coromandelica*. The leaves are bipinnately imparipinnate, leaflets three on each secondary rachis, opposite, ovate in *Cardiospermum halicacabum*. The margin is entire in all except in *Cardiospermum* and *Allophyllus*, where it is serrate-obtuse and serrulate respectively. The apex is acute in four taxa acuminate in *Mangifera*, while retuse in *Sapindus* and *Buchanania* but obtuse in *Anacardium* and *Semecarpus*. Leaf base is obtuse in five taxa but acute in *Dodonaea* and *Mangifera*, cordate in *Semecarpus* and rounded in *Lannea*.

The general venation pattern is planiusculus (Veins distributed in one plane in the mesophyll; cf. Prabhakar and Ramayya, 1982), pinnate brochidodromous in all except in *Allophyllus* and *Cardiospermum* where it is pinnate craspedodromous and craspedobrochidodromous (Proximal secondaries terminating at the margin as craspedodromous and the distal secondaries joining superadjacent secondaries forming loops) respectively (Figs. 1CD). The thickness of the primaries are stout in all but weak in *Dodonaea* and *Cardiospermum* and moderate in *Sapindus*. The course of the primaries are usually straight in all the taxa but curved in *Dodonaea* (Fig. 1A).

The number of secondaries produced by the midvein vary from 12 to 44 (Figs. 1C, 3A). However besides

Received March 1993

these secondaries, in *Mangifera* there are five to eight pairs of minor secondaries at the apex (secondaries present in the narrow apical region of the leaf; cf Anna Mani and Prabhakar, 1991a). The secondaries are alternate to opposite in *Dodonaea, Sapindus* and *Allophyllus* (Figs. 1A-C), opposite to alternate in five other taxa (Figs. 1D, 2AB, 3B), alternate to subopposite in *Buchanania* (Fig. 3A). The angle of divergence of secondaries vary from acute narrow to acute moderate in *Cardiospermum* and *Dodonaea* (Figs. 1AD); acute moderate to acute wide in *Allophyllus, Sapindus* and *Mangifera* (Figs. 1BC 3B); right angle to acute moderate in *Anacardium, Buchanania, Lannea* and *Semecarpus* (Figs. 2AB, 3A). They are relatively thick in all but in *Dodonaea* they are moderately thick. The course of the secondaries are straight but abruptly curved at margins in *Anacardium, Buchanania* and *Mangifera* (Figs. 2A, 3AB), feably sinuate but abruptly curved at margins in *Dodonaea* and *Sapindus* (Figs. 1AB), retroflexed but abruptly curved at margin in *Lannea* and *Semecarpus* (Figs. 2B), while uniformly curved in *Allophyllus*. In *Cardiospermum* proximal secondaries are uniformly curved while the distal secondaries uniformly curved but abruptly curved near margin (Figs. 1D). The secondary veins are branched in *Buchanania* and *Semecarpus* (Figs. 2B, 3A), while in *Cardiospermum* (Fig. 1D) only the lower secondaries are branched. The secondaries are forming loops throughout in all, except in *Cardiospermum* where they are restricted to the apex. However, in *Allophyllus* loop forming secondaries are absent. The loop forming branches join the superadjacent secondaries usually at right angle to obtuse angle in *Buchanania, Lannea* and *Semecarpus* (Figs. 3A, 2B), acute angle to obtuse angle in *Anacardium* and *Mangifera* (Figs. 2A, 3B) and obtuse angle throughout in *Dodonaea, Sapindus* and *Cardiospermum* (Figs. 1ABD). The loop forming branches are enclosed by arches of 3 and 4° veins in all the nine taxa. Intersecondary veins are present in *Dodonaea, Sapindus, Allophyllus, Buchanania* and *Mangifera* (Figs. 1ABC, 3AB) and are of simple type. Tertiaries are predominantly percurrent throughout the lamina in all but reticulate in the leaf apex of *Allophyllus, Cardiospermum* and *Lannea*. The percurrent tertiaries are predominantly branched and retroflexed in *Buchanania, Mangifera, Sapindus* and *Semecarpus*, zigzag in *Anacardium*, straight to zigzag in *Allophyllus* and *Lannea*. They are simple, zigzag as well as sinuate in *Dodonaea* and convex to straight in *Cardiospermum*. They are alternate to opposite in seven taxa (Figs. 1BC, 2AB, 3AB) and opposite in *Dodonaea* and *Cardiospermum*. The angle of origin of tertiaries are predominantly right angle: right angle (RR) and acute angle: right angle (AR) in *Sapindus. Cardiospermum. Anacardium. Dodonaea* and *Mangifera* (Figs. 1ABD, 2A, 3B), right angle right angle (RR) in *Semecarpus. Allophyllus. Buchanania* and *Lannea* (Figs. 1C, 2B, 3A). the relationship of tertiaries to midvein is oblique constant in *Dodonaea. Sapindus. Allophyllus* and *Mangifera* (Figs. 1ABC, 3B) and oblique but longitudinal downward in *Anacardium. Buchanania* and *Lannea* (Figs. 2A, 3A), longitudinal but oblique outward and upward in *Semecarpus* (Fig. 2B) while perpendicular but oblique outward in *Cardiospermum* (Fig. 1D).

The next finer order 4° and 5° veins are distinct in *Dodonaea. Allophyllus. Cardiospermum* and *Lannea* (Fig. 1ACD) and upto 6°veins in rest of the taxa (Figs. 1B, 2AB, 3AB). The higher order of veins are orthogonal reticulate. The marginal ultimate venation is looped in six taxa (Figs. 1A-D, 2A) and fimbriate in *Semecarpus, Buchanania* and *Mangifera* (Figs. 2B, 3AB).

The development of the areoles are imperfect and randomly arranged in all taxa. The shape of the areoles vary from pentagonal (Figs. 1bc. 2ab, 3a) to quadrangular (Figs. 11ad, 3b) and are medium sized (128-288/cm^2) in eight taxa and large (48-100/cm^2) in *Lannea*. The number of areoles/cm^2 very from 48 to 288. the number of veinlets/areole is one in all taxa. The veinlets are thrice branched and curved in four taxa (Figs. 2ab, 3ab), branched twice and straight in *Sapindus* and curved in *Lannea*, branched once and curved in *Allophyllus* and *Dodonaea* but simple and curved in *Cardiospermum*.

All the above foliar characters are found to be of taxonomic value and based on the above a key for identification of Sapindales occurring at Visakhapatnam is provided below.

Key for identification of the Taxa :

1. Venation brochidodromous type
2. Secondaries branched
3. Basal secondaries retroflexed ..... *Semecarpus anacardium*
3. Basal secondaries not retroflexed .....*Buchanania axillaris*
2. Secondaries not branched

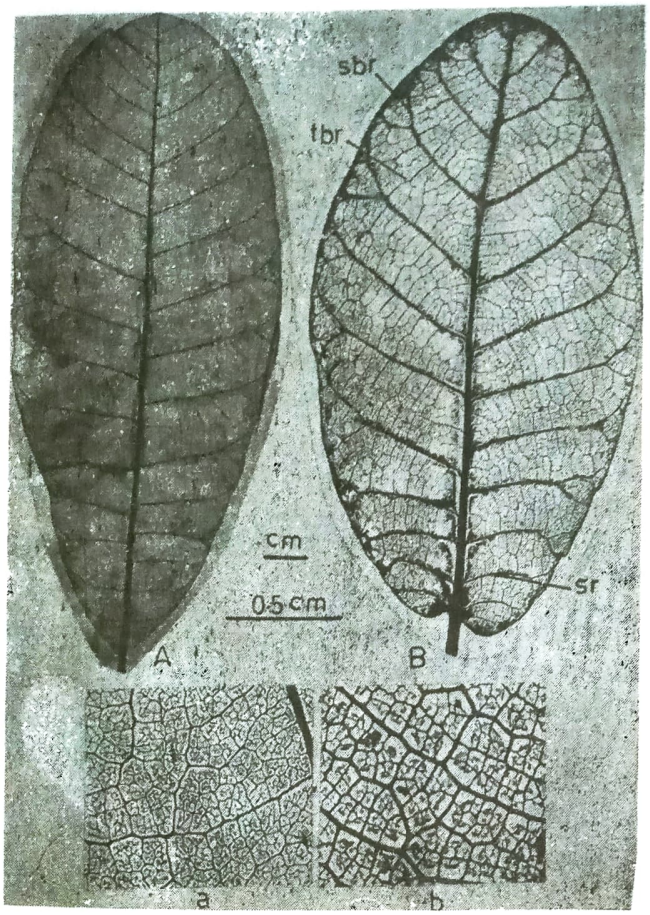

Figure 2A,B. Leaf showing Pinnate brochidodromous venation patterns, a,b. enlarged portion from middle of the leaf showing areoles and veinlets in *Anacardium occidentale* and *Semecarpus anacardium* respectively (sbr-secondaries branched; sr - secondaries retroflexed; tbr - tertiaries branched).

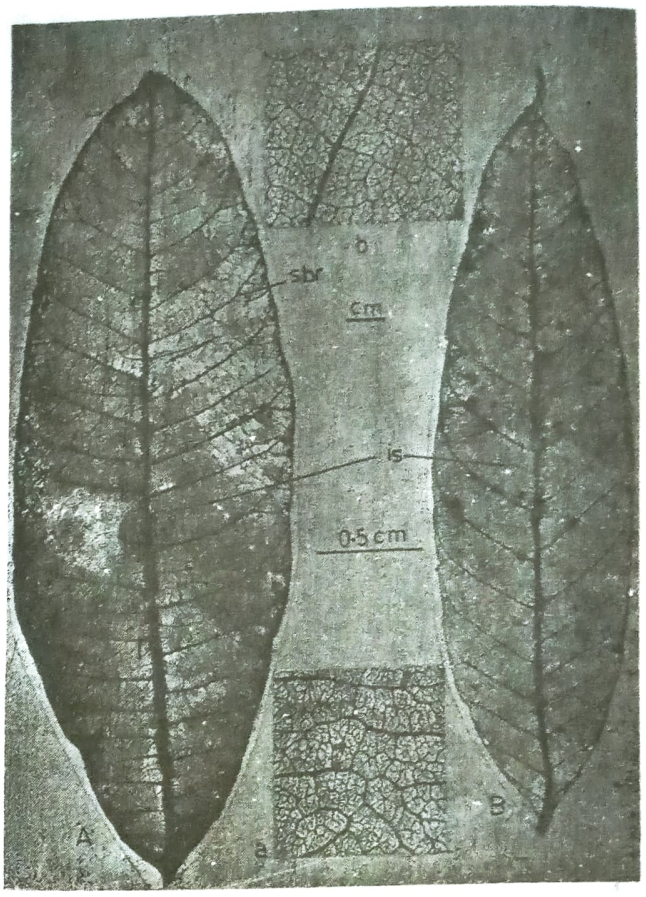

Figure 3A,B. Leaf showing Pinnate brochidodromous venation patterns. a,b. enlarged portion from middle of the leaf showing areoles and veinlets in *Buchanania axillaris* and *Mangifera indica* respectively. *(is - intersecondary; sbr-secondaries branched).*

4. Leaves compound
5. Leaf paripinnate, leaflets oblong .....*Sapindus emarginata*
5. Leaf Impripinnate, leaflets ovate ..... *Lannea coromandelica*
4. Leaves simple
6. Intersecondary veins absent .....*Anacardium occidentale*
6. Intersecondary veins present
7. Number of intersecondary veins 18 .....*Dodonaea viscosa*
7. Number of intersecondary veins 8 ..... *Mangifera indica*
1. Venation craspedodromous or craspedo-brochidodromous type
8. Venation craspedodromous .....*Allophyllus cobbe*
8. Venation craspedo-brochidodromous .....*Cardiospermum halicacabum*

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