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Nodal vasculature in some Burseraceae

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ABSTRACT

The vascular organization of the node in six genera has been investigated. The leaves are imparipinnately compound. These are alternate and exstipulate. A study of the nodal organisation of 15 members of the family Burseraceae revealed three nodal types: I. Trilacunar three traced, II. Pentalacunar five-traced and III. Multilacunar multi-traced. Trilacunar three-traced condition has been observed in 13 out of 15 species investigated. Whereas multilacunar multi- traced condition has been observed in species of *Canarium.* It is significant to note that *Garuga pinnata* in addition shows a trilacunar three-traced and pentalacunar five-traced condition. Trilacunar three-traced condition is considered to be basic for this family and it is believed that the pentalacunar five-traced condition and multilacunar-multitraced condition is a subsequent development through an elaboration of the lateral in the course of evolution.

Key words: Burseraceae, Node, Nodal evolution.

The Burseraceae is a moderate-sized family includes 18 genera and some 540 species of trees and shrubs from tropical and subtropical areas of Africa, Arabia, the Indian subcontinent and the Americas. While studying the nodal organization in the angiosperms, Sinnott[7] have reported the pentalacunar nodal structure in the Burseraceae. Since the nodal vasculature in the family has received little attention, it warrants a detailed study. Consequently the present study were undertaken to study the nodal organization of 15 species distributed in 6 genera.

The plant materials of *Commiphora berryi* (Arn) Engl., *Commiphora caudata* (Wight & Arn.) Engl., *Canarium strictum* Roxb. and *Protium caudatum* Wight & Arn. were collected from Lalbagh Botanical Garden, Bangalore where as *Bursera delphichiana* Poiss. ex. Engl. *Bursera simaruba* (L.) Sarg., *Garuga pinnata* Roxb. and *Boswellia serrata* Roxb. were collected from Waghai. *Bursera serrata* Wall. ex. Colebr., was collected from

Agra while *Commiphora wightii* (Arn.) Bhandari, *Commiphora allagocha* Engl. and *Commiphora pubescens* Engl. collected from Jawaharlal Neharu research centre, Pune and that of *Canarium commune* L. obtained from the Mumbai. *Commiphora mukul* Engl. and *Commiphora myrrha* (Nees) Engl. were collected from the Nagarjuna medicinal garden, Akola. The plant materials fixed in F.A.A. were preserved in 70% alcohol. Free hand serial sections of the young nodal regions as well as microtome sections were prepared following usual method of dehydration, clearing and embedding in paraffin wax. These were stained either in safranin-light green combination or crystal violet and erythrosine.

The leaves are imparipinnately compound. These are alternate and exstipulate. In all the species examined, the internodal region shows a complete vascular cylinder. In the nodal region, variable numbers of leaf traces diverge from the main vascular cylinder leaving behind prominent gaps.

Trilacunar three-trace node:

In *Boswellia serrata*, *Bursera delphichiana*, *B. serrata*, *B. simaruba*, *Commiphora allagocha, C. berryi, C. caudata, C. myrrha, Garuga pinnata* Roxb. and *Protium caudatum* the median trace emerges out first and the two lateral traces diverge out at the higher level (Figs. 1-2, 9-11, 18-19), where as all the three traces are given out simultaneously from the main stele in *Commiphora mukul*, *C. pubescens* and *C. wightii*, (Figs. 5-6).

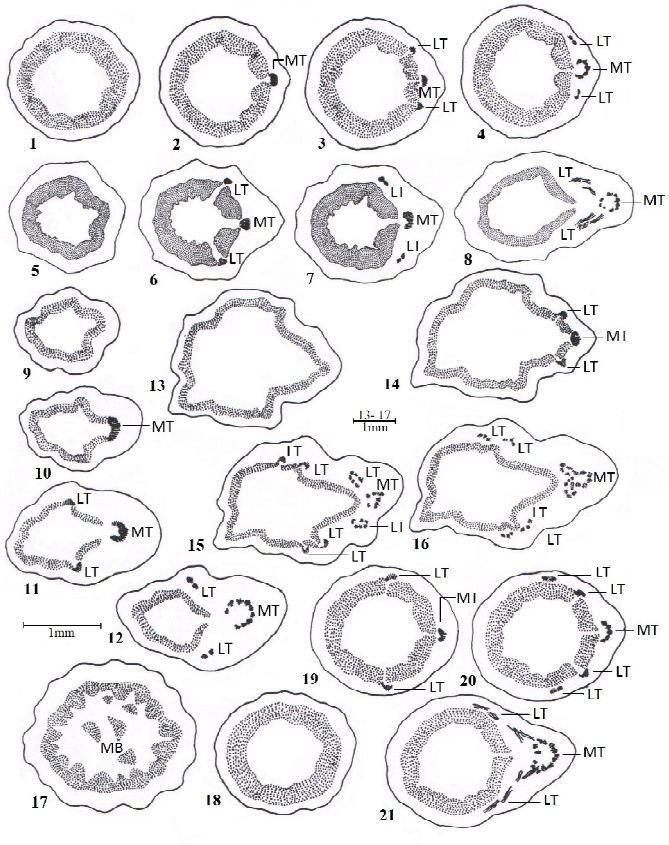
The median bundle is broad in *Boswellia serrata, Bursera delphichiana, B. simaruba, Commiphora allagocha, C. berryi, C. mukul, C. myrrha, C. pubescens, C. wightii* and *Protium caudatum* and more prominent and arc-like in the remaining taxa wherein it breaks up into 5, 10 or more traces. The lateral bundles divide, may not divide during their upward course and extend along with the daughter strands of median bundle, into the rachis.

Pentalacunar five-trace node:

In few nodes *of Garuga pinnata* pentalacunar five-trace condition has been observed. The axial vascular cylinder first sends off a broad median trace leaving behind a gap (Figs.18-19). The second pair of lateral traces is derived next, while the first pair of laterals diverges out later (Fig. 20). The broad, arc-lie median trace splits into 8-10 daughter strands while each of lateral bundles splits into two (Fig. 21). All the traces develop a ring and enter into the rachis. The node is pentalacunar, five-traced.

Multilacunar multi-trace node:

In *Canarium strictum* and *C. commune*, a broad and prominent median trace is derived from the main stele leaving behind a gap. The median bundle undergoes divisions into twelve to many daughter traces. The first pair of laterals is the next to emerge (Figs. 13-14). The second and third pairs of laterals are given out successively in the end (Fig. 15). All the lateral traces now traverse towards the median. The first pair of laterals splits into three-five strands, while the remaining laterals divide into three strands. All these traces unite to form a ring like structure (Fig.16) and enter into the rachis. Some of the daughter strands of the median trace acts as medullary bundles in the



Explanation of Figures:
Figs.1-11 and 13-18 Transections showing structure of foliar node, Fig. 17. Transection showing structure of rachis of *Canarium commune*; Figs. 1-4. *Garuga pinnata*; Figs. 5-8. *Commiphora wightii*; Fig. 9-12. *Boswellia serrata*; Fig.13-16. *Canarium strictum*; Fig. 18-21. *Garuga pinnata.*
Abbreviations used: MT- Median trace; LT- Lateral trace; MB- Medullary bundles

rachis (Fig. 17). The node is multilacunar multi- traced.

This study brings out interesting variations in the nodal structure; the most common nodal condition is the trilacunar three-trace. It has been observed in 13 out of 15 genera investigated. The genus *Garuga* has both trilacunar as well as pentalacunar five-trace structure of node. In *Canarium strictum* and *C. commune,* multilacunar multi-trace structure of node is seen. Generally, the median trace emerges prior to the laterals. It is interesting to note that the median trace and lateral traces emerge simultaneously in *Commiphora mukul, C. pubescens* and *C. wightii*. The median bundle is broad or more prominent, arc-like in the majority of the plants and shows a number of divisions in its upward course. In certain plants like *Canarium strictum* and *C. commune* the median bundle gives rise to medullary bundles, which extend separately within the stelar structure of the rachis. Metcalfe and Chalk[5] recorded the medullary strands in *Canarium*. The lateral bundles also show divisions. These variations in the division of the medians and laterals may be looked upon from the points of view of mechanical strength and size of leaf.

While reviewing the nodal structure in angiosperms, Sinnott[7] writes that the pentalacunar nodal structure occurs in the Burseraceae. The present study indicates that the trilacunar three-trace nodes occur in the majority of the taxa studied, while the pentalacunar structure is noted only in few nodes of *Garuga pinnata.* In addition a third nodal type, the multilacunar multi-traced condition also exists in *Canarium strictum* and *C. commune*.

Sinnott[8] has emphasized the significance of the leaf trace and leaf gap in the systematics. Conflicting views have been expressed by various workers regarding the evolutionary conception of vegetative node in angiosperms, suggesting both reduction and/or amplification of vascular traces during the course of specialization (see Sinnott[7], Ozenda[6], Marsden and Bailey[3], Meeuse[4], Dickison[1], Stebbins[9]). Later, Takhtajan[10,11] postulated tri-or multilacunar type of nodal structure with double trace in median gap as the most primitive one, which has given rise to all the nodal types known presently.

The present study demonstrates that the node is trilacunar three-trace in the majority of the taxa. *Garuga pinnata* has trilacunar as well as pentalacunar nodal structure. *Canarium* has multilacunar nodal condition. This leads the present authors to infer that pentalacunar in *Garuga* and multilacunar condition in *Canarium* is a subsequent development through an elaboration of the lateral in the course of evolution. Eames[2] also arrives at similar conclusion of the nodal structure in this family. Thus the present observations lend support to the view of Sinnott[7, 8] and Eames[2].

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