NODAL ORGANIZATION IN HAMAMELIDIDAE

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ABSTRACT

Nodal organization in 17 species, 16 genera and 9 families of the Hamamelididae has been investigated. Among these *Cannabis sativa*, *Distylium racemosum*, *Eucommia ulmoides*, *Hamamelis japonica*, *H. virginiana*, *Juglans regia* and *Pouzolzia hirta* show unilacunar, uni-traced condition ; *Betula utilis*, *Boehmeria macrophylla*, *Maoutia puya*, *Myrica nagi* and *Parrotia persica* are unilacunar, tri-traced; whereas *Celtis australis*, *Corylopsis spicata*, *Ficus glomerata*, *F. palmata* and *Morus alba* are unilacunar, multi-traced.

INTRODUCTION

Comparison of nodal anatomy may be valuable for showing relationship or distinctness of genera or even species (SINNOTT, 1914; OZENDA, 1949; BAILEY, 1966; PANT & MEHRA, 1964; BENZING, 1967; PHILIPSON & PHILIPSON, 1968; DICKINSON, 1975; THOMAS, 1907; KUMAR, 1976). Examples of systematic application of nodal data are offered by the works of CANRIGHT (1955). Although most of the families tend to have a uniform nodal anatomy, some families, genera, species and even a single plant show variable nodal organization (MARSDEN & BAILEY, 1956; SEHGAL & PALIWAL, 1974).

Regarding the distribution of nodal types, it is generally believed that the trilacunar, tri-traced node occurs in majority of the dicotyledons (SINNOTT, 1914), whereas the multi-lacunar condition in a number of primitive orders such as Magnoliales, Piperales, Trochodendrales and a few advanced orders like Umbellales and Asterales (HOWARD, 1970). The unilacunar node has an interesting distribution mainly in the Laurales (*sensu* TAKHTAJAN, 1969), Caryophyllales, Ericales, Diapensiales, Ebenales, Primulales, and Myrtales, few families of the Tubiflorae, such as Acanthaceae, and Scrophulariaceae and a majority of families in Asteridae. Some orders show transition of nodal structure, e.g. the representatives of Theales.

MATERIAL AND METHODS

The nodal organization of 17 species belonging to 7 families of the Hamamelididae as listed below has been investigated :

Sl. no.	Name of the Taxa	Family	Place of collection
1.	*Corylopsis spicata* Sieb. *et* Zucc.	Hamamelidaceae	Heidelberg West Germany
2.	*Distylium racemosum* Sieb. *et* Zucc.	—do—	—do—
3.	*Hamamelis japonica* Sieb. *et* Zucc.	—do—	—do—
4.	*H. virginiana* L.	—do—	—do—
5.	*Parrotia persica* C.A. Meg.	—do—	—do—
6.	*Eucommia ulmoides* Oliv.	Eucommiaceae	—do—

(*Contd.*)

(*Contd.*)

Sl. no.	Name of the Taxa	Family	Place of collection
7.	*Celtis australis* L.	Ulmaceae	Srinagar-Garhwal
8.	*Ficus glomerata* Roxb.	Moraceae	—do—
9.	*F. palmata* Forsk.	—do—	—do—
10.	*Morus alba* L.	—do—	—do—
11.	*Cannabis sativa* L.	Cannabianaceae	—do—
12.	*Boehmeria macrophylla* Don.	Urticaceae	—do—
13.	*Maoutia puya* Wedd.	—do—	—do—
14.	*Pouzolzia hirta* Hassk.	—do—	—do—
15.	*Betula utilis* Don.	Betulaceae	—do—
16.	*Myrica nagi* Thunb.	Myricaceae	Pauri-Garhwal
17.	*Juglans regia* L.	Juglandaceae	—do—

The materials employed for the present investigation consisted of herbarium specimens and fresh materials collected either locally or from different botanical gardens. The internal organization of node has been studied mostly in hand sections as well as microtome sections of 10 μm thickness and stained with safranin-fastgreen combination. Illustrations have been drawn with the help of camera lucida, micro-slide projector, or a photographic enlarger. Serial sections passing through the node as well as the regions just above and below were employed to trace the initiation of vascular supply to the leaves.

OBSERVATIONS

In the family Hamamelidaceae, the species *C. spicata* shows unilacunar, multi-traced condition (Fig. 1A), *P. persica,* unilacunar tri-traced condition (Fig. 1 E) while the node is unilacunar, uni-traced in *D. racemosum* (Fig. 1 B), *H. japonica* (Fig. 1C) and *H. virginiana* (Fig. 1D). The representatives of the family Eucommiaceae, *E. ulmoides* (Fig. 1F) shows unilacunar, uni-traced condition. In Ulmaceae, *C. australis* (Fig. 1 G) shows an unilacunar, multi-traced condition. The three investigated taxa of the family Moraceae, *F. glomerata* (Fig. 1 H), *F. palmata* (Fig. 1 I) and *M. alba* (Fig. 2A), exhibit an unilacunar, multi-traced condition.

The representatives of the family Urticaceae, *B. macrophylla* (Fig. 2C) and *M. puya* (Fig. 2D), show unilacunar, tri-traced condition, whereas *P. hirta* (Fig. 2E) shows unilacunar, uni-traced condition. In the Betulaceae, *B. utilis* (Fig. 2F) and in Myricaceae, *M. nagi* (Fig. 2G) show unilacunar, tri-traced condition, while *Juglans regia* (Fig. 2H) of Juglandaceae, has a unilacunar tri-traced node.

Thus among 17 taxa studied here, 7 species of four families show unilacunar, tri-traced condition. Five species of four families are unilacunar, tri-traced while five species of three families are unilacunar, multi-traced. The followings groups have been erected on the basis of the nodal feature :

I. Unilacunar Uni-traced

1. *Distylium racemosum* Hamamelidaceae


NODAL TYPES
IN
HAMAMELIDIDAE
EUCOMMIA-CEAE
ULMACEAE
MORACEAE
HAMAMELIDACEAE
A
B
C
D
E
F
G
H
I

Fig. 1

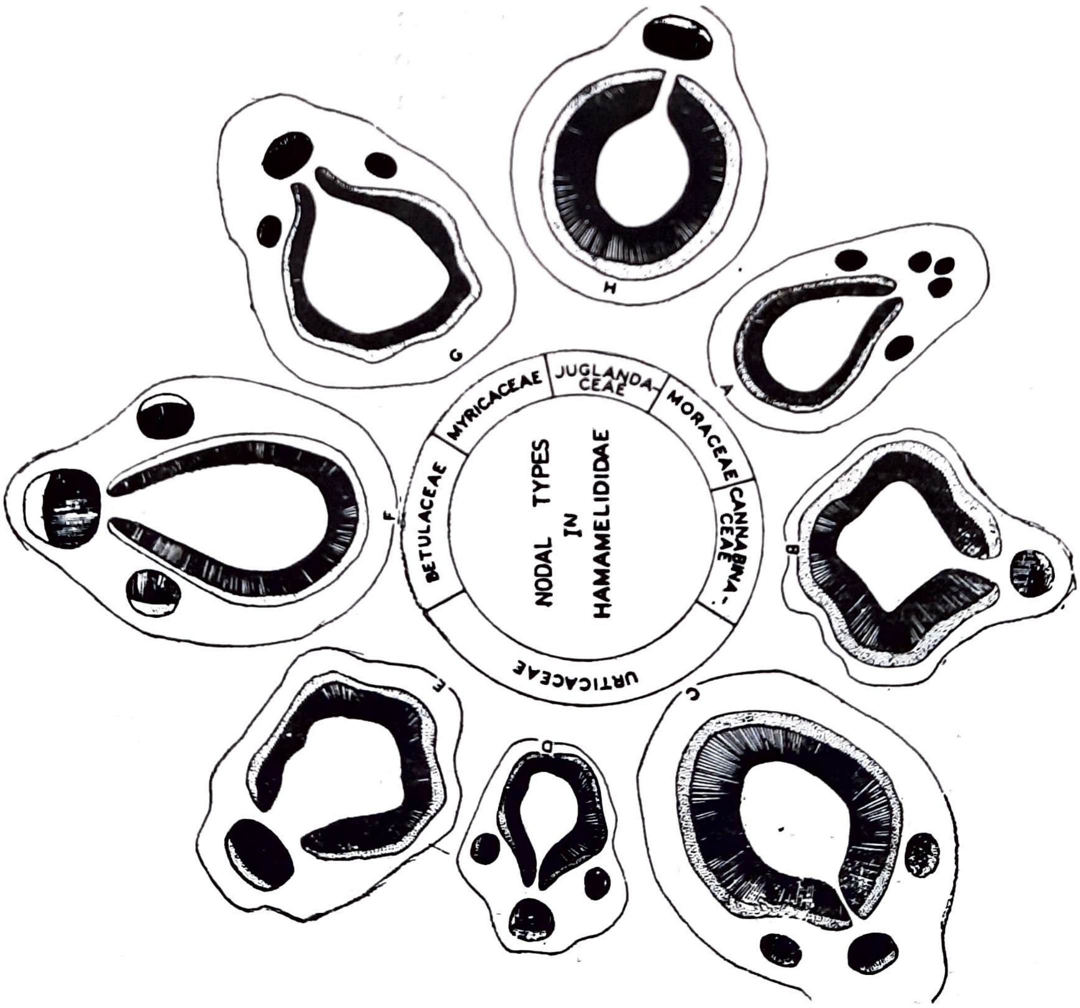
NODAL TYPES
IN
HAMAMELIDIDAE
BETULACEAE
MYRICACEAE
JUGLANDA-CEAE
MORACEAE
CANNABINA-CEAE
URTICACEAE
A
B
C
D
E
F
G
H

Fig. 2

2.	*Hamamelis japonica*	Hamamelidaceae
3.	*H. virginiana*	—do—
4.	*Eucommia ulmoides*	Eucommiaceae
5.	*Cannabis sativa*	Cannabinaceae
6.	*Pouzolzia hirta*	Urticaceae
7.	*Juglans regia*	Juglandaceae
II.	Unilacunar Tri-traced	
1.	*Parrotia persica*	Hamamelidaceae
2.	*Boehmeria macrophylla*	Urticaceae
3.	*Maoutia puya*	—do—
4.	*Betula utilis*	Betulaceae
5.	*Myrica nagi*	Myricaceae
III.	Unilacunar Multi-traced	
1.	*Corylopsis spicata*	Hamamelidaceae
2.	*Celtis australis*	Ulmaceae
3.	*Ficus glomerata*	Moraceae
4.	*F. palmata*	—do—
5.	*Morus alba*	—do—

DISCUSSION

Of all the features, nodal organization has been considered to be of much phylogenetic significance in vascular plants since the beginning of the present century, although there are divergent opinions on the primitive types of nodes. In general, the trilacunar tri-trace condition is considered primitive (SINNOTT, 1914); as compared to the multilacunar node (OZENDA, 1949). However, a detailed study on cotyledonary and foliar nodes by CANRIGHT (1955) and MARSDEN AND BAILEY (1956) have suggested that the unilacunar, tri-traced condition is the forerunner of other types, a point earlier stressed by THOMAS (1907) (*see also* PANT & MEHRA, 1964). In addition, BENZING (1967) and PHILIPSON AND PHILIPSON (1960) corroborated the view that the nodes with odd number of traces are likely to be more primitive, whereas TAKHTAJAN (1969) postulated the hypothetical node, trilacunar or multilacunar type with double traces departing from the median gap, is at the base of the ladder. Mention must also be made of the report of KUMAR (1976) who recorded a unique type of node which is bilacunar, tri-traced.

Amplification and reduction are supposed to be important trends in the evolution of different nodal patterns of the angiosperms, although none of the earlier workers agree to the mode of operation of amplification or reduction occurring in different taxa. Thus, a perusal of the literature of nodal anatomy suggests this aspect to be considered independently in different groups of plants as also pointed out by CRONQUIST (1968) and STEBBINS (1974).

The present study in the group Hamamelididae reveals that the node is unilacunar in all the investigated taxa. However, variation does occur in the organization especially in the behaviour of the subsequent traces in the foliage. As many as seven families show unilacunar, uni-traced node, whereas amongst the remaining ones, Hamamelidaceae (*C. spicata*), Ulmaceae (*C. australis*) and Moraceae (*F. glomerata, F. palmata* and *M. alba*) exhibit an unilacunar, multi-traced situation.

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REFERENCES

BAILEY, I. W. (1956). Nodal anatomy in retrospect. *J. Arnold Arbor.*, **37** : 269-287.

BENZING, D. H. (1967). Developmental pattern in stem primary xylem of woody Ranales. II. Species with trilacunar and multilacunar nodes. *Am. J. Bot.*, **54** : 813-820.

CANRIGHT, J. E. (1955). The comparative morphology and relationship of Magnoliaceae. IV. Wood and nodal anatomy. *J. Arnold Arbor.*, **36** : 119-140.

CRONQUIST, A. (1968). *The Evolution and Classification of Flowering Plants*. Boston.

DICKINSON, W. C. (1975). Leaf anatomy of Cunoniaceae. *Bot. J. Linn. Soc.*, **71** : 275-294.

HOWARD, R. A. (1970). Some observations on the node of woody plants with special reference to the problem of the split laterals versus the common gap. *In* : N.K.B. Robinson *et ol.* (eds.)-*New Research in Plant Anatomy*, New York.

KUMAR, A. (1976). A new type of nodal organization in angiosperms. *Acta. Bot. Indica.*, **4** : 76-77.

MARSDEN, M. P. F. & BAILEY, I. W. (1956) A fourth type of nodal anatomy in dicotyledones illustrated by *Clerodendron trichotomum* Thunb. *J. Arnold Arbor.*, **36** : 1-51.

OZENDA, P. (1949). Researches sur les dicotyledones apocarpiques contribution a des Angiosperms dites primitives. *Trav. Lab. Ecol. Norm. Super. Ser. Biol.*, **2** : 1-183.

PANT, D. D. & MEHRA, BHARATI (1964). Nodal anatomy in retrospect. *Phytomorphology*, **14** : 384-387.

PHILIPSON, W. R. & PHILIPSON, M. N. (1968). Diverse nodal types in *Rhododendron*. *J. Arnold Arbor.*, **49** : 193-224.

SEHGAL, LALITA & PALIWAL, G. S. (1974). Studies on the leaf anatomy of *Euphorbia* II. Venation patterns. *Bot. J. Linn. Soc.*, **68** : 173-208.

SINNOTT, E. W. (1914). Investigations on the phylogeny of the angiosprm. I. The anatomy of the node as an aid in the classification of angiosperms. *Am. J. Bot.*, **1** : 303-322.

STEBBINS, G. L. (1974). *Flowring Plants : Evolution above the Species Level.* Cambridge.

TAKHATAJAN, A. (1969). *Flowering Plants : Origin and Dispersal.* London.

THOMAS, E. N. (1907). A theory of the double leaf trace founded on seedling structure. *New Phytol.*, **6** : 77-91.