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THE STEM NODE LEAF CONTINUUM IN *VERBESINA ENCELIOIDES (CAV.) BENTH. & HOOK.* AND *BIDENS BITERNATA (LOUR.) MERR. & SHERFF.* OF TRIBE HELIANTHEAE (ASTERACEAE)

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Data on stem node leaf continuum in *Verbesina encelioides* and *Bidens biternata* are presented. In both the specimens, the node has trilacunar and three trace condition.In *V. encelioides*, the principal variations were studied at the nodal region where the median trace does not divide soon after its origin from the main vascular system and it is not uncommon for lateral leaf traces to divide prior to their corporation into the vascular system of petiole. In *B. biternata* the three traces enter the base of the petiole where the laterals split up. The five traces continue up to the lamina. The petiolar anatomy with both median and lateral traces traveling upto the leaf apex is identical in both the species.

Keywords : *Bidens biternata*; Stem-node-leaf continuum; Trilacunar and three trace node; *Verbesina encelioides.*

Introduction

The previous account of nodal anatomy clearly reveals that there is no much work, on Asteraceae and more particularly on Indian members of Asteraceae, has been carried out. The present work proposes to fill up that gap in a modest way. By the serial transverse sections and clearing methods nodes and petioles were studied in order to properly understand the branching of the leaf trace bundles. The data on number of gaps and number of leaf traces that originate from the stem, the details of petiole vascularization like the number of traces, their branching etc. in *V. encelioides* and *B. biternata* the commonly grown species in Rajasthan, are presented here.

Material and Methods

Samples of internodes, nodes and leaves were collected from the 2nd to 4th nodal portion of *V. encelioides (Cav.)Benth.&Hook.* and *B. biternata* (Lour.) Merr. & Sherff. and fixed in FAA[1] and maintained in 70% ethanol solution[2]. After that they were processed through TBA series and embedded in paraffin 56°C melting point[1]. Serial transverse sections, cut at 8-10 µm, were stained with safranin-fast green combination. The sections were dewaxed with pure xylene and rehydrated in alcohol series[3] following with some modifications.

Nodes were also prepared by clearing the tissue in lactophenol (Lactic acid : Phenol : Glycerine) in the ratio 1:1:2. The cleared nodes were stained in 0.5% safranin and mounted in glycerin[4].

Observations

V. encelioides is a much branched erect, herb, 75 to 150 cm high and bearing leaves which showed two distinct growth patterns. The lower leaves are opposite and triangular, while the upper ones are alternate and lance shaped. They are 5 to 14 cm long, the lowest being long petioled and shortly auricled at the base. Upper leaves gradually become sessile. All leaves have fine white hairs on the underside. These fine white hairs are also present on the stem (Fig. 1 A-C).

B. biternata is an erect, oppositely branched and nearly 1 meter high annual herb. Stems are more or less four angled with glabrous surface. Leaves are simple or compound. When compound they usually consist of two, subopposite pairs of lateral leaflets and a deeply three lobed terminal leaflet, the latter being larger than the former. Petioles are 3-4 cm long and somewhat dilated and sheathing at the base. Simple leaves are linear in shape, acute and about 1.2 to 1.5 cm long (Fig. 1 D-F).

The nodal anatomy

V. encelioides - The distal (bearing opposite leaves), middle (bearing subopposite leaves) and proximal (bearing alternate leaves) nodes showed opposite, gradually subopposite and alternate vascular patterns, respectively. Six leaf traces, three lateral traces on one side and three lateral traces on the other side, are seen at the nodes where the leaves are subopposite at each node or opposite in arrangement (Fig. 2C). The two laterals to one leaf LT_1,

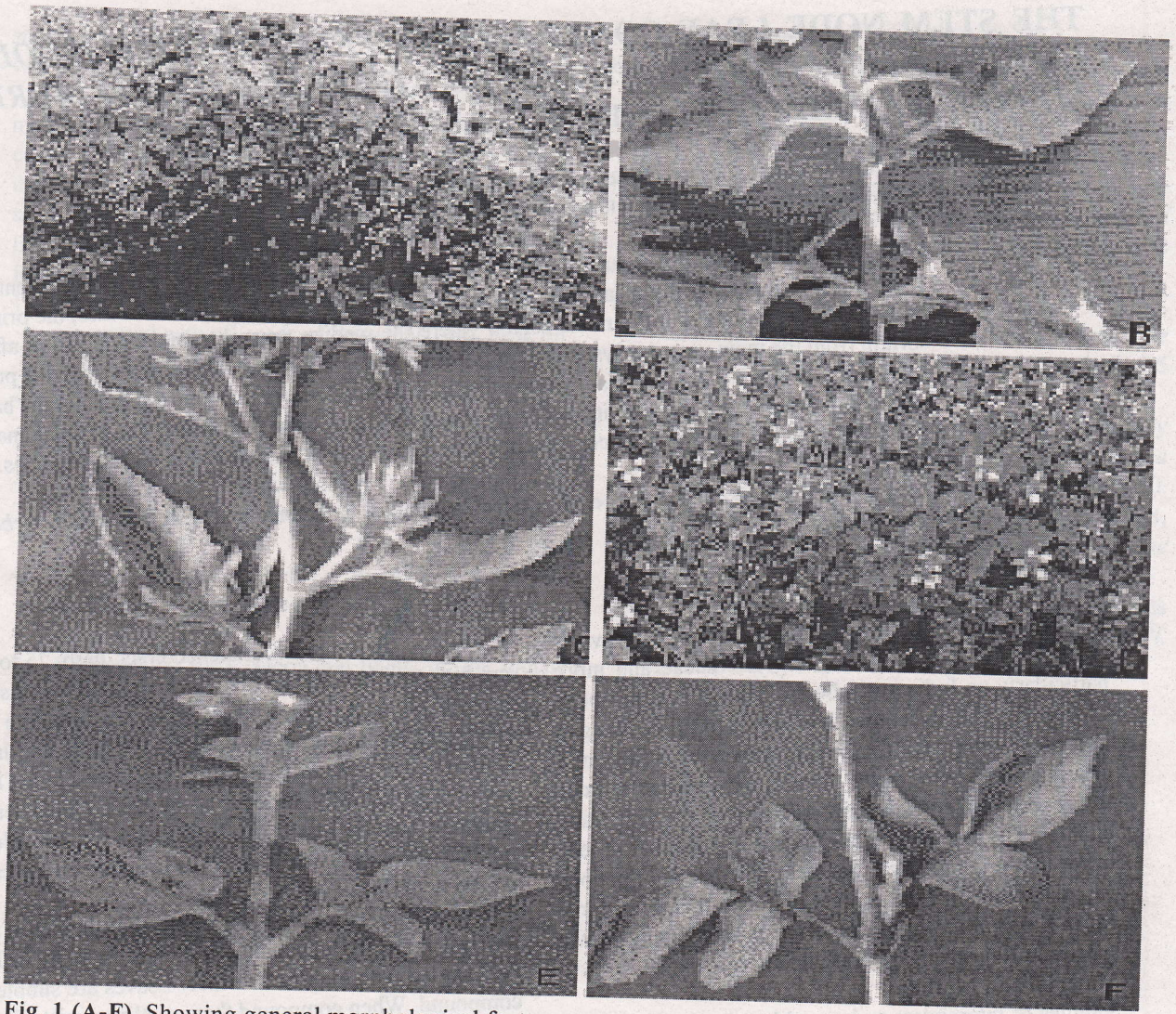

Fig. 1 (A-F). Showing general morphological features.
Figs. A-C *V. encelioides*, A, habit of plant, B, distal nodes showing phyllotaxy, C, proximal nodes showing phyllotaxy.
Figs. D-F *B. biternata*, D, habit of plant, E, twig with proximal nodes, F, twig with distal nodes.

LT_2 depart one by one at different levels followed by the median (MT) (Fig. 2D). Similarly, traces for the second leaf on opposite side leave the axis vasculature. The lateral traces leave the main axis vasculature earlier at each node and the median trace continues without branching upto the middle of the lamina (Fig. 2E).The lateral gaps are immediately filled with differentiating procambial tissue. The median gap is filled only after the axillary bud supply (Fig. 2E). The margins of the two leaves of a node remain fused up till they are completely free from the axis (as seen in V.S.) (Figs. 2C-E). The traces to two leaves of a node with opposite phyllotaxy depart almost at the same level (Fig. 2C), where those at a node with subopposite condition depart at marginally different levels (Fig. 2D).The traces for successive nodes with alternate leaves are departing at considerably different levels (Fig. 2E). The two lateral traces (LT_1, LT_2) to a leaf, divide soon after departure from the node (Fig. 2F), and the two small bundles(one on either side) get housed below the margins which are seen as two flaps in the vertical section(Fig. 3B-D). The remaining vasculature of each trace alongwith the median in between them enter the petiole base.

B. biternata- Six leaf traces, three lateral traces on one side and three lateral traces on the other side, are present at the nodes as the leaves are opposite in arrangement (Fig. 4A). The two laterals to one leaf

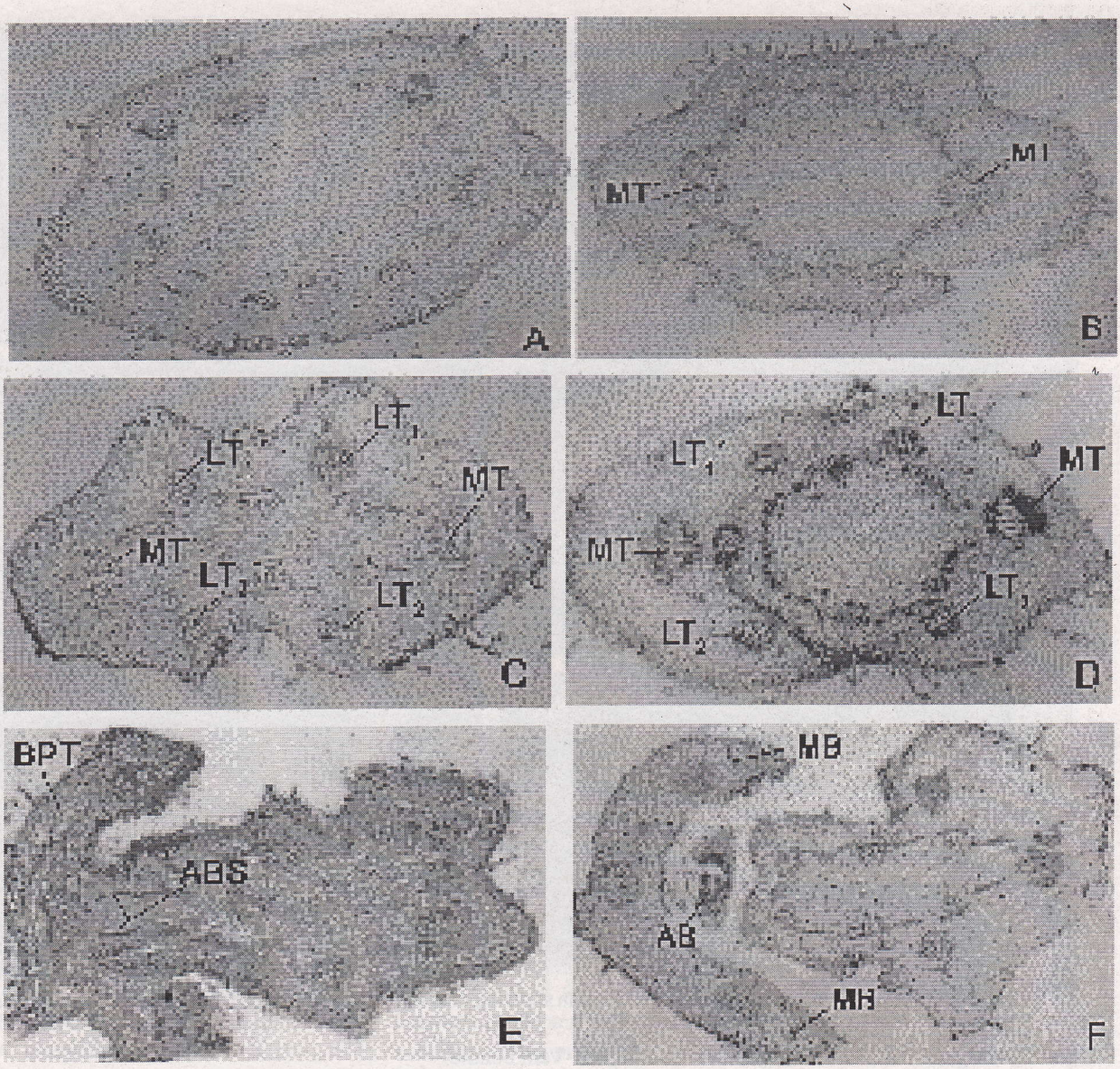

Fig. 2 (A-F) Transverse sections through internode, node and petiole of *V. encelioides.*
Figs. A, internodal vasculature (X 100), B, the median traces of the two leaves are preparing to depart (X 100), C, D, departure of the three traces to each leaf (X 100), E, F, departure and entry into petiole base of traces with alternate condition (X 100).
AB - Axillary bud; ABS - Axillary bud supply; BPT - Base of petiole; LT_1, LT_1', LT_2, LT_2' - Lateral traces; MT, MT' - Median traces.

LT_1, LT_2 depart at almost the same level followed by the median (MT) (Fig. 4B-E). The median traces (MT) continues without branching upto the middle of the lamina, and its gap is filled only after the axillary bud supply (Fig. 4C). The two lateral traces (LT_1 and LT_2) to a leaf divide soon after departure from the node. In Fig. 4 E-F, the two small bundles MB (one on either side) get housed below the margins which are seen as two flaps in the vertical section (Figs. C-D). The remaining vasculature of each trace

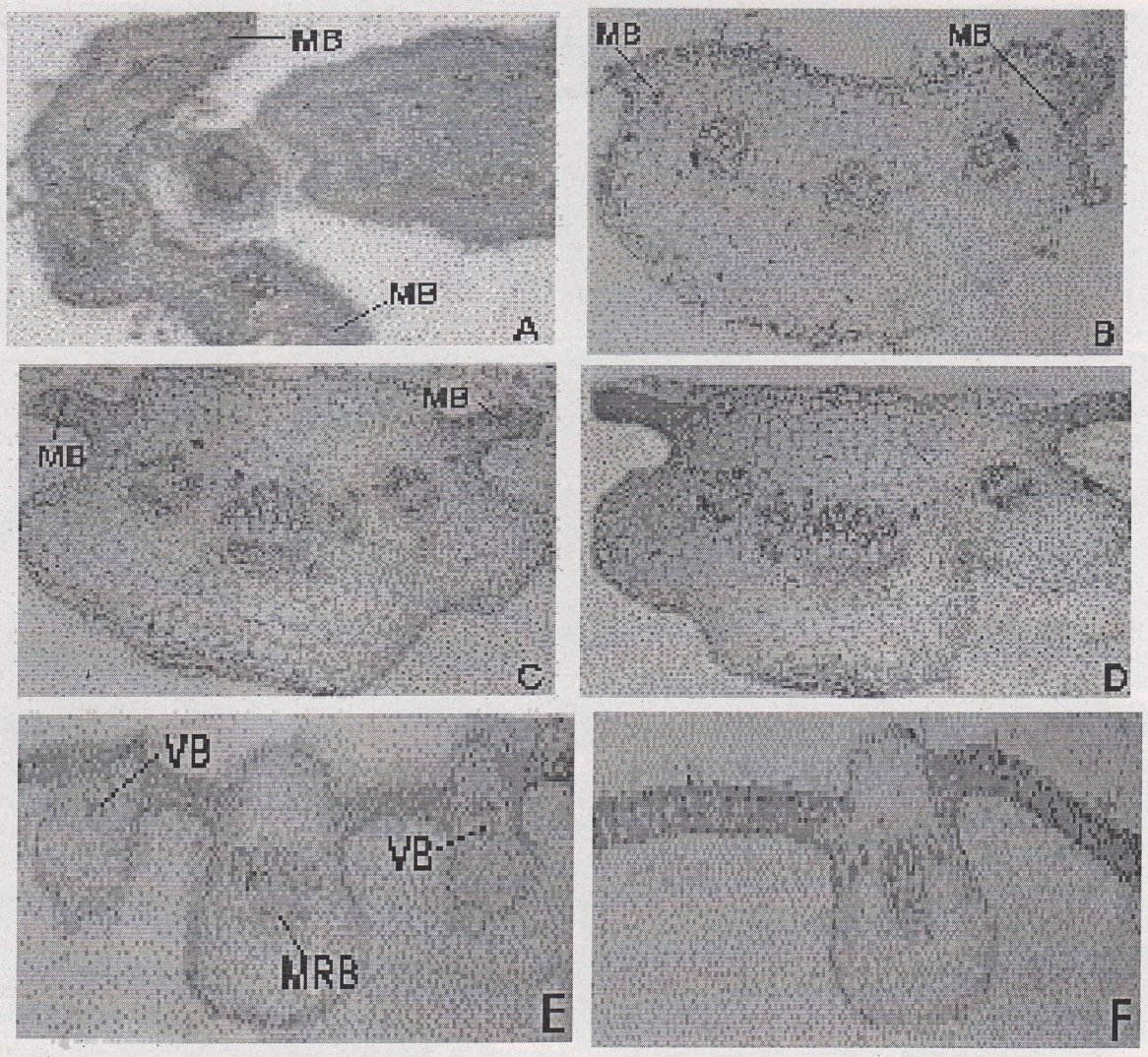

Fig.3(A-F). Transverse sections of petiole and lamina showing course of vasculature at different levels in *V. encelioides* (X 100)
MB - Marginal bundle; MRB - Mid rid bundle; VB-Vein bundle.

alongwith the median enter the base of the petiole (Fig. 4F), separately.

The petiole anatomy

The three traces to a leaf remain separate throughout the petiole length. Small bundles from each side of the median separate and join with the laterals on their respective sides prior to laminar supply. These compound lateral bundles become the vasculature of the major veins in the lamina. The median bundle becomes the midrib vasculature. Branches from the lateral sides of this and the vein bundles separate out towards the tip and supply the lamina (Figs. 3 B-E,5 E-F).Near the tip portion, the two vein bundles move towards the main midrib bundle gradually and fuse with it to form a common large bundle (Fig. 3F,and Fig. 6C).

Discussion

The nodal structure in both *Verbesina encelioides* and *Bidens biternata* shows a three trace trilacunar condition. The earlier reports available on the nodal anatomy of members of Asteraceae point to predominance of trilacunar three trace conditions at foliar nodes. However, exceptions have also been reported in the form of seven lacunar seven trace type in *Elephantopus scaber*[5]; eight lacunar eight trace node in *Brachyglottis repanda*[6] and a five lacunar five trace node in *Senecio myrianthos*.

All the nodes in *B. biternata* had opposite leaves. In *V. encelioides* the placement of leaves differed at the

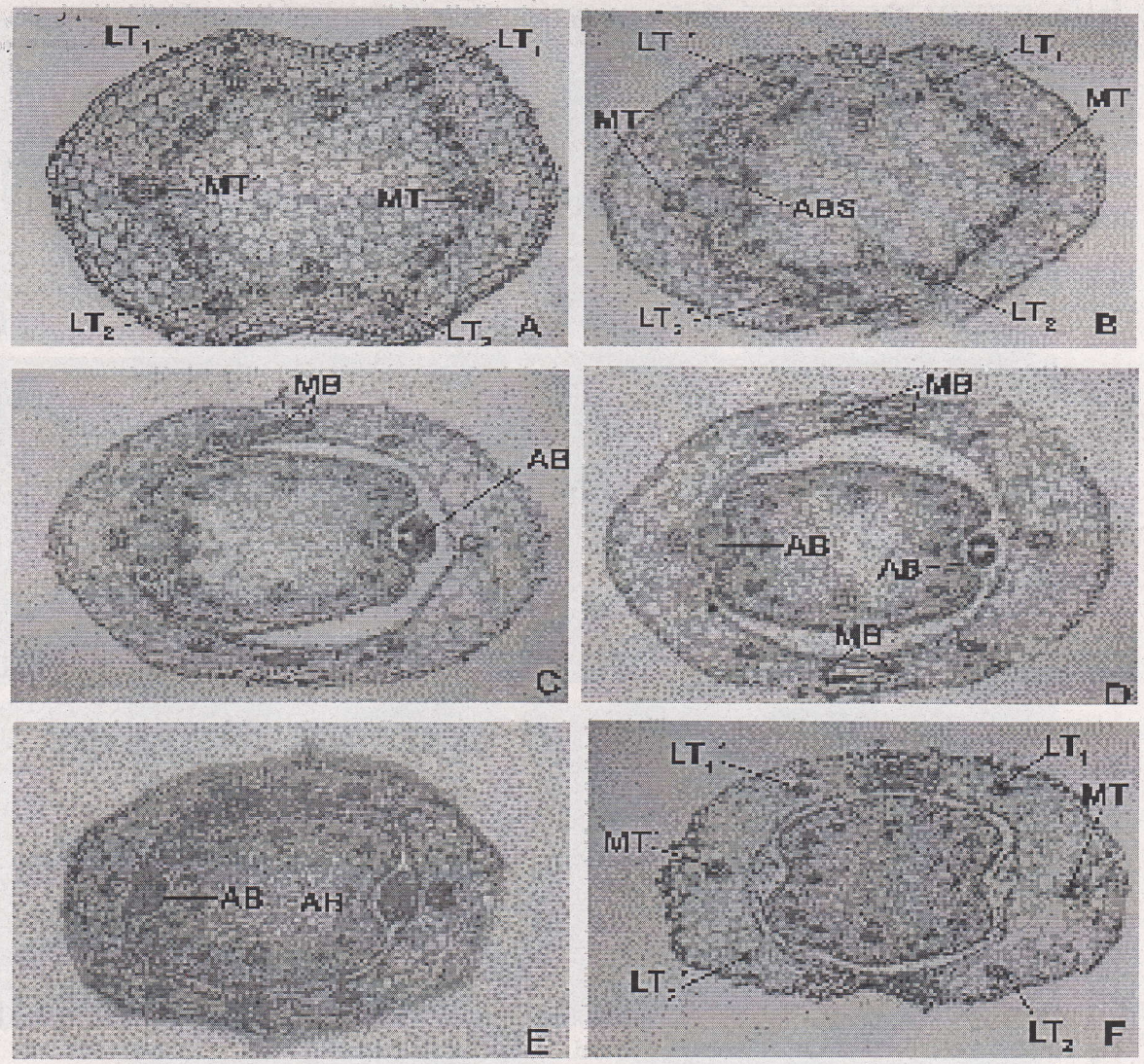

Fig. 4(A-F). Transverse sections through internode, node and petiole of *B. biternata.*
A, internodal vasculature (X 100); B–E, sections showing preparation and departure of traces at trilacunar three trace nodes with opposite phyllotaxy and axillary bud supply (X 100); F, showing branching of the lateral traces forming marginal bundles (X 100).
AB – Axillary bud; ABS – Axillary bud supply; LT_1, LT_1', LT_2, LT_2' - Lateral traces; MB – Marginal bundle; MT, MT′ – Median traces.

basal, middle and upper nodes as opposite, subopposite and alternate types, respectively. However, the vascular supply to all leaves at each node in both the species showed uniform pattern. This indicates the advisability of ontogenetic studies before arriving at final conclusions.

In both the species the three traces to a leaf showed similar patterns of origin and further course in the cortex and base of leaf and in the petiole. The data agree with those reported by Elias[7] and Pillai and Sharma[8] in *Pithecolobium* species where the vascular traces of the petiole are derived from all three leaf traces. Nodal anatomical studies provide one of the most reliable evidences for classification and possibly for phylogenetic studies. Even though systematic are not sure of the course of evolution of foliar characters in flowering plants, but their (node, petiole, leaf characters) diagnostic value has never been in doubt. Dickison[9] suggested that the trilacunar three trace pattern is the ancestral type from which the

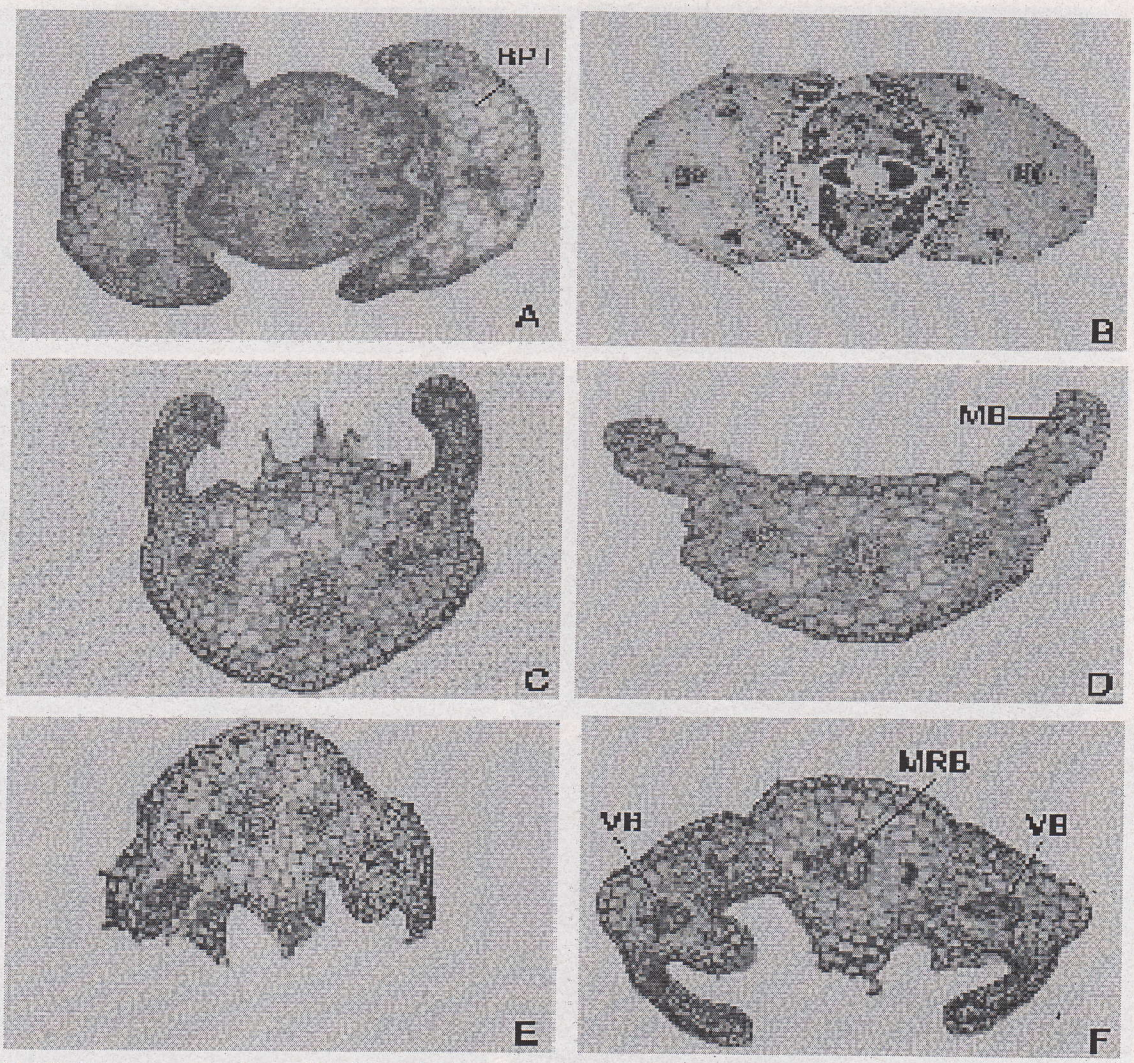

Fig. 5(A-F). Transverse sections of node, petiole and lamina of *B. biternata*
A,B, vasculture at the bases of the petioles (X 100); C,D, course of vasculature in the petiole at different levels (X 100); E,F, sections showing midrib and lateral veins vasculatures (X 100). BPT – Base of petiole; MB – Marginal bundle; MRB – Mid rib bundle; VB – Vein bundle

multilacunar condition evolved by amplification in the number of lateral traces. Earlier, Sinnott[10] also considered this type of node to be primitive. On the basis of floral and other characters the family Asteraceae has long been considered to be an evolved taxon. It is interesting that the nodal structure, which has been supported to be of primitive nature, is present in the evolved family.

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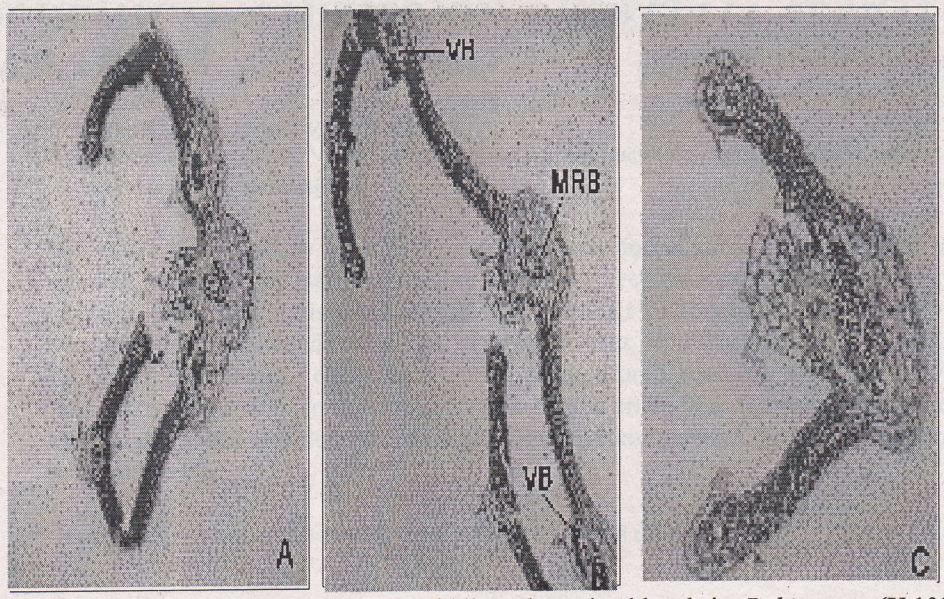

Fig. 6(A-C). Transverse sections of lamina at distal, middle and proximal levels in *B. biternata* (X 100). MRB – Mid rib bundle ; VB – Vein bundle

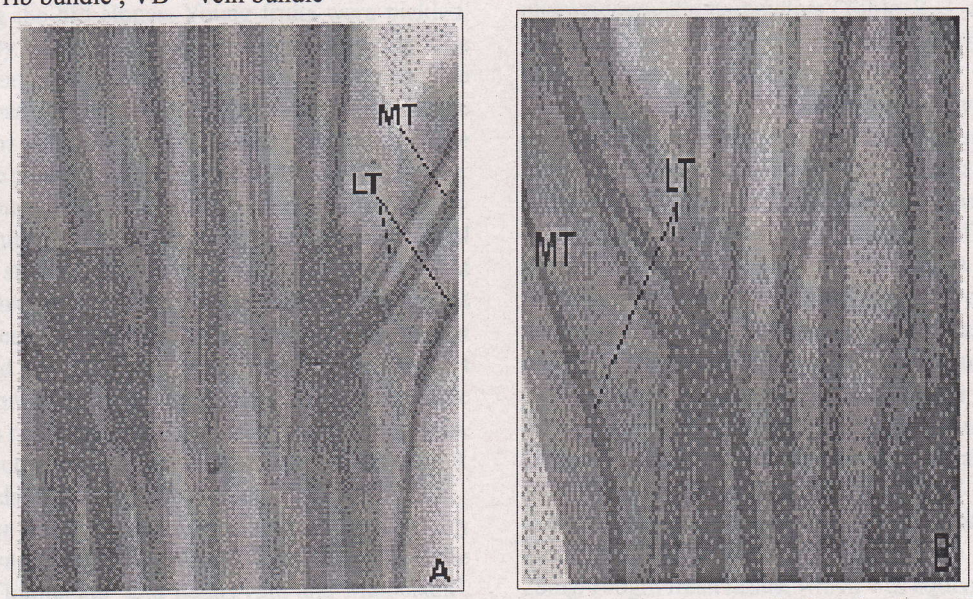

Fig. 7(A-B). Showing vasculature at nodes (Fig. A. *V. encelioides*, Fig. B. *B. biternata*) after clearing with lactophenol treatment method (X 100).

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