

## STEM-NODE-LEAF CONTINUUM IN *ABRUS PRECATORIUS* LINN.

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Data on stem-node-leaf continuum in *Abrus precatorius* Linn. are presented. The leaf is pinnately compound and the rachis terminates into a spinule. Three bundles depart from the stem vasculature and enter the petiole, at the base of which they divide and fuse to form a ring of vasculature resembling that of the internodal stele as being conjoint, collateral and open. The stipules are supplied by the branches from the laterals. The petiole vasculature after supplying the leaflet pairs enters the spinule in the form of a small arc bundle with the xylem facing adaxially. This resembles the midrib vasculature of simple leaf in general and indicates the foliar nature of the spinule.

**Keywords :** *Abrus precatorius* Linn.; Stem-Node-Leaf continuum; Trilacunar three-trace.

### Introduction

*Abrus precatorius* Linn. is an important weed of Rajasthan (India) becoming rare. Its fruit is used medicinally and in various commercial and ornamental purposes. Taxo-anatomical studies of important and rare plants could be useful in various discussions of systematics and biodiversity conservation.

Philipson and Balfour<sup>1</sup> supported by Benzing<sup>2,3</sup> considered the primary vascular tissue or bundles having considerable pattern diversity and hence could be a source of data of systematic value. Howard<sup>4</sup>, Pillai and Sharma<sup>5</sup>, Sharma and Pillai<sup>6</sup>, Dubey *et al.*<sup>7</sup> and Negi *et al.*<sup>8</sup> reported the stem-node-leaf continuum in some angiosperms and discussed their importance in taxonomy. Data on the vasculature through the internode, node, petiole and rachis in *Abrus precatorius* Linn. are presented here.

### Material and Methods

8-10 samples each of internode, node and petiole were collected from the *Abrus precatorius* Linn. plants grown in village Agar, Distt. Alwar, Rajasthan (India). These were fixed in FAA, processed through TBA series and embedded in paraffin wax. Serial transverse sections cut at 8-10  $\mu$ m were stained with safranin and light green combination. Measurements were taken from the sixth node and the distances have reference to the point of departure of the first lateral trace.

### Results and Discussion

*Abrus precatorius* Linn. is a perennial,

twinning shrub bearing about 5 to 8.5 cm long alternate, stipulate and unipinnate compound leaves. The rachis of each leaf terminates into a small spinule. Each leaf bears 14-16 leaflet pairs which are about 1-1.7 x 0.3-0.5 cm mucronate, oblong and obtuse. The proximal and distal 2-3 pairs are small in size than the middle ones. Base of the petiole, rachis and leaflet surface are covered with hairs.

*The internode :* The stem is woody and roughly circular in outline in the internodal region. The epidermis consists of rectangular thick walled cells with thick cuticle on the outer surface. Uniseriate epidermal hairs with 2-3 cells each, the upper most cell of which is globose, are present. The cortex is made of 6-7 layers of isodiametric or angular cells with dense cytoplasm and have intercellular spaces. Uniseriate endodermis discontinued here and there is present in young stems. The pericycle has 3-4 cell layers of thick walled sclerenchyma.

A continuous ring of conjoint, collateral and open vasculature surrounds a broad parenchymatous pith in the internodal region. The number of xylem groups may correspond with the number of vascular bundles which is 11-15 at the levels depending upon the distance from the lower node. Each xylem group has one to several rows of angular tracheary elements with the protoxylem pointing towards the centre (Figs. 1, 22A).

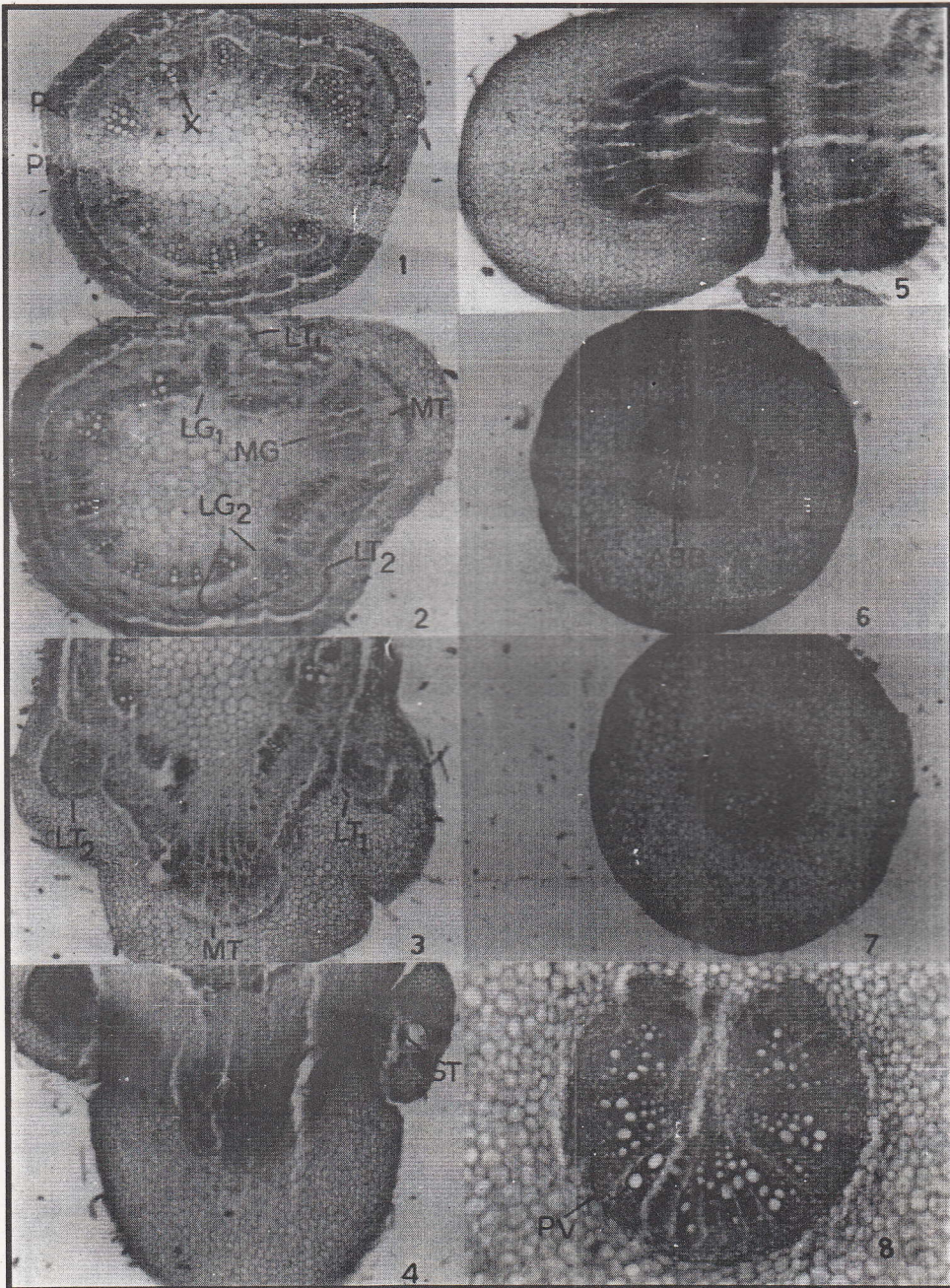
*The node :* Three larger vascular groups bulge out from the axis to form three traces

to a leaf. These bundles (vascular groups) start preparing themselves to leave the stele at almost the same level. But, the anodic lateral leaves the stele slightly earlier (at 0.114 mm) than the cathodic lateral (at 0.160 mm). The median is the last to leave in that order (at 0.176 mm) (Figs. 2, 22B). The gaps in the stele formed due to laterals are closed immediately by fresh procambium differentiation where as the median gap is closed after supplying the axillary bud and the laterals approach the median during their course in the cortex and fuse with it at the base of the petiole (Figs. 3, 22C). The laterals first give off branches (ST) to supply the stipules (S) on either sides (Figs. 4, 22C, E and F). Then they curve and bifurcate. Their abaxial branches join the median to form a large abaxial arc (ABB). These two vascular groups (ABB and ADB) (Figs. 5, 22F, G, and H), which are oriented inversely, fuse at higher levels (at 0.472 mm) and form a ring of collateral vasculature (Figs. 6, 7, 22I). Soon (at 0.52 mm) parenchyma cells appear in this ring on the adaxial side and the vasculature becomes 'U' shaped (Figs. 8, 22J). Two small vascular groups (RT<sub>1</sub> and RT<sub>1</sub>') near the adaxial ends of the 'U' vasculature, separate (at 0.616 mm) and get housed as ridge bundles in the two adaxial ridges of the rachis (Figs. 9, 22K). The remaining rachis vasculature is drawn into five bundles (at 0.656 mm) viz., two adaxial bundles (LB<sub>1</sub> and LB<sub>1</sub>'), two lateral bundles (LB<sub>2</sub> and LB<sub>2</sub>') and a large abaxial bundle (AVB) (Figs. 22L, M). The two leaflets of the first-pair are supplied (at 1.936 and 1.952 mm). The ridge bundles move towards the axis of the rachis and branches from these and from LB<sub>1</sub>' and LB<sub>2</sub>' on one side and LB<sub>1</sub>' and LB<sub>2</sub>' on the other side fuse and enter the leaflets (LLV<sub>1</sub> and LLV<sub>1</sub>') on their respective sides (Figs. 11, 22N). The two leaflets are seem to be opposite externally but they receive their vasculature at two different levels (as if they are alternate) though the distance between them is very shorts (0.016 mm). All the remaining leaflet pairs except the last one, are supplied in the similar manner (Figs. 13, 15, 16 and 22P, R, S, V, W).

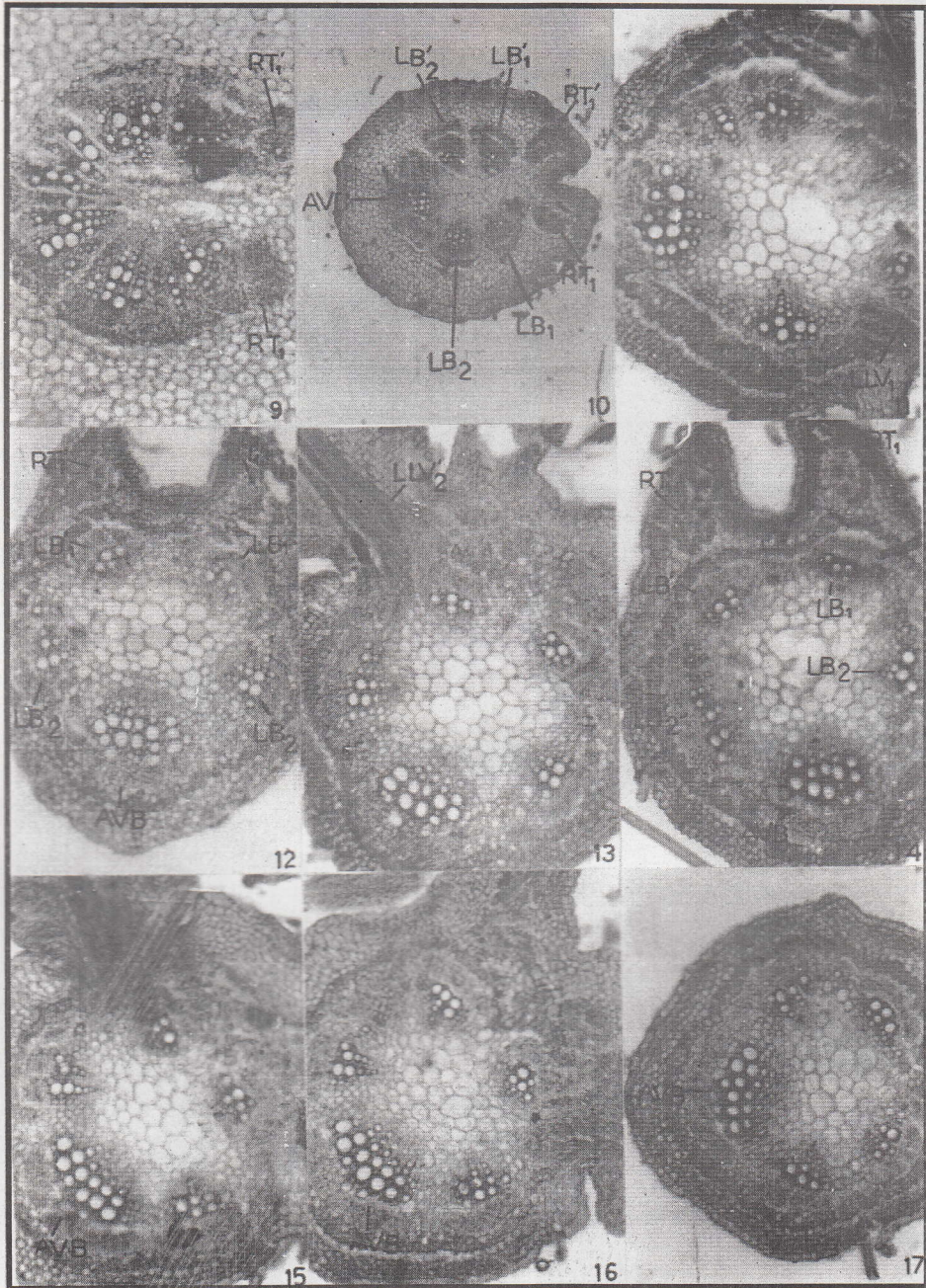
All the bundles i.e. the ridge bundles (RT<sub>1</sub> and RT<sub>1</sub>') and LB<sub>1</sub> and LB<sub>1</sub>' and LB<sub>2</sub> and LB<sub>2</sub>' bundles resume their original shape, structure and position after supplying the successive pair of leaflets except the last pair (Figs. 14, 17 and 22O, Q, T). After supplying the last but one pair, the ridge bundles however move to the ridge and the LB<sub>1</sub> and LB<sub>1</sub>' also take their original position but LB<sub>2</sub> and LB<sub>2</sub>' bundles get fused with the AVB bundles on their respective sides forming a large abaxial arc at 5.08 mm level (Figs. 18 & 22U). Prior to supplying the last pair of leaflets, the LB<sub>1</sub> and LB<sub>1</sub>' bundles also fuse with the large abaxial arc. Ridge bundles now move towards this arc and branches from the fuse with the ridge bundles and supply the last pair of leaflets at 10.768 mm level (Figs. 22Z). After supplying the last-pair of leaflets, only a small 'V' shaped vasculature remains in the rachis axis (Figs. 21 and 22ZZ). This become the vasculature of the spinule terminating the rachis.

The node is trilacunar three-trace. The two laterals depart one by one at different levels followed by the median, the distance between them being short. The laterals before approaching the median at the base of petiole send branches to supply the stipules whereas the bundles supplying the axillary branches arise from the margins of the gap associated with the median trace. This is in accord with the previous reports on tree legumes<sup>5-7</sup>.

The three traces anastomose at the petiole base and form a siphonostele which first becomes arcuate resembling the midrib vasculature pattern of a simple leaf and then become reorganized into separate bundles arranged in a ring, resembling the stem vascular pattern, and two bundles in the ridges. Sharma and Pillai<sup>6</sup> observed this type of petiole vasculature in *Acacia*. There are examples of cases where the stem axis vasculature also have cortical and medullary bundles which are treated as leaf trace bundles. The ridge bundles may be considered parallel with the cortical bundles i.e. leaf trace bundles as they are also supplying the



**Figs. 1-8.** Transverse sections through internode, node and petiole of *Abrus precatorius* Linn.  
 Fig. 1. Internodal vasculature x 50  
 Fig. 2,3. Departure of three traces to a leaf x 50  
 Fig. 4. Departure of stipular traces and anastomosis of the three traces x 50  
 Fig. 5-8. Changes in the petiole vasculature 5,7 x 50; 8 x 100. (ABB - Abaxial bundle, ADB - Adaxial bundles; LG<sub>1</sub> and LG<sub>2</sub> - Lateral gaps; LT<sub>1</sub> and LT<sub>2</sub> Lateral traces; MG - Median gap; MT - Median trace; P - Pericycle; PH - Phloem; ST - Stipular trace; X - Xylem.)



**Figs. 9-17.** Transverse sections of the rachis.

Fig. 9-12. Showing departure of ridge bundles. x 100

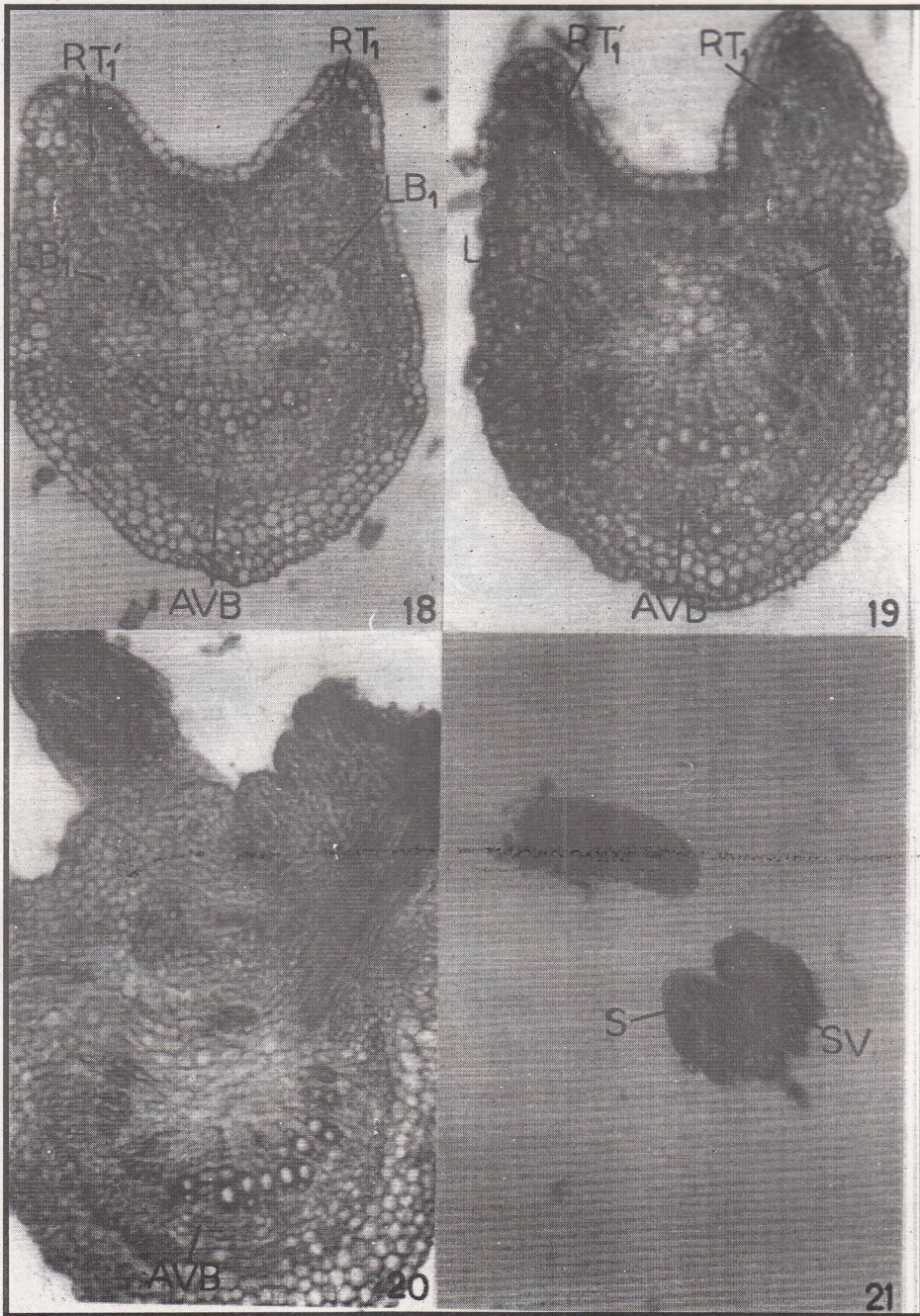
Fig. 13. Supply to the first pair of leaflets. x 100.

Fig. 14. Rachis vasculature after supplying the leaflet. x 100.

Fig. 15,16. Vasculature to the second pair of leaflets x 100.

Fig. 17. Rachis vasculature showing continuous ring of multilayered pericycle. x 100.

(AVB - Abaxial vascular bundle; LB<sub>1</sub>, LB<sub>1</sub>', LB<sub>2</sub> and LB<sub>2</sub>' - Lateral bundles; RT and RT' - Ridges bundles.)

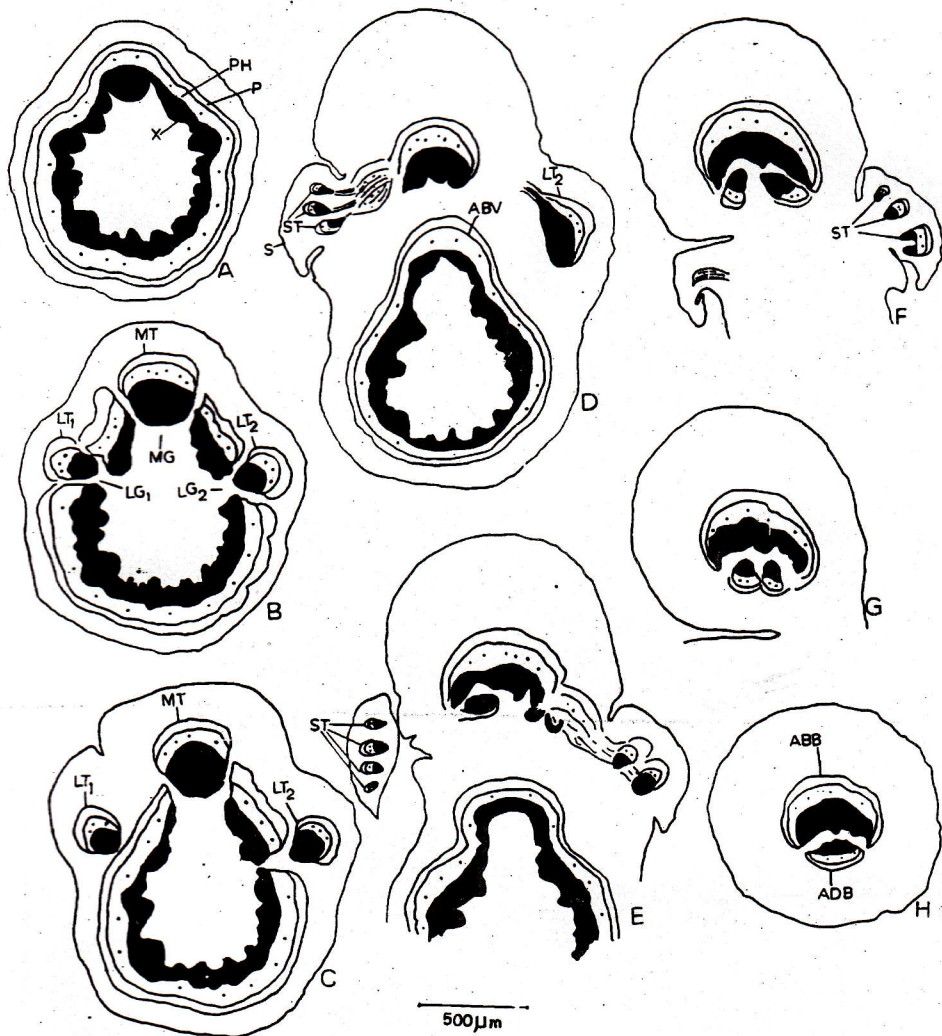


**Figs. 18-21.** Transverse sections of the rachis.

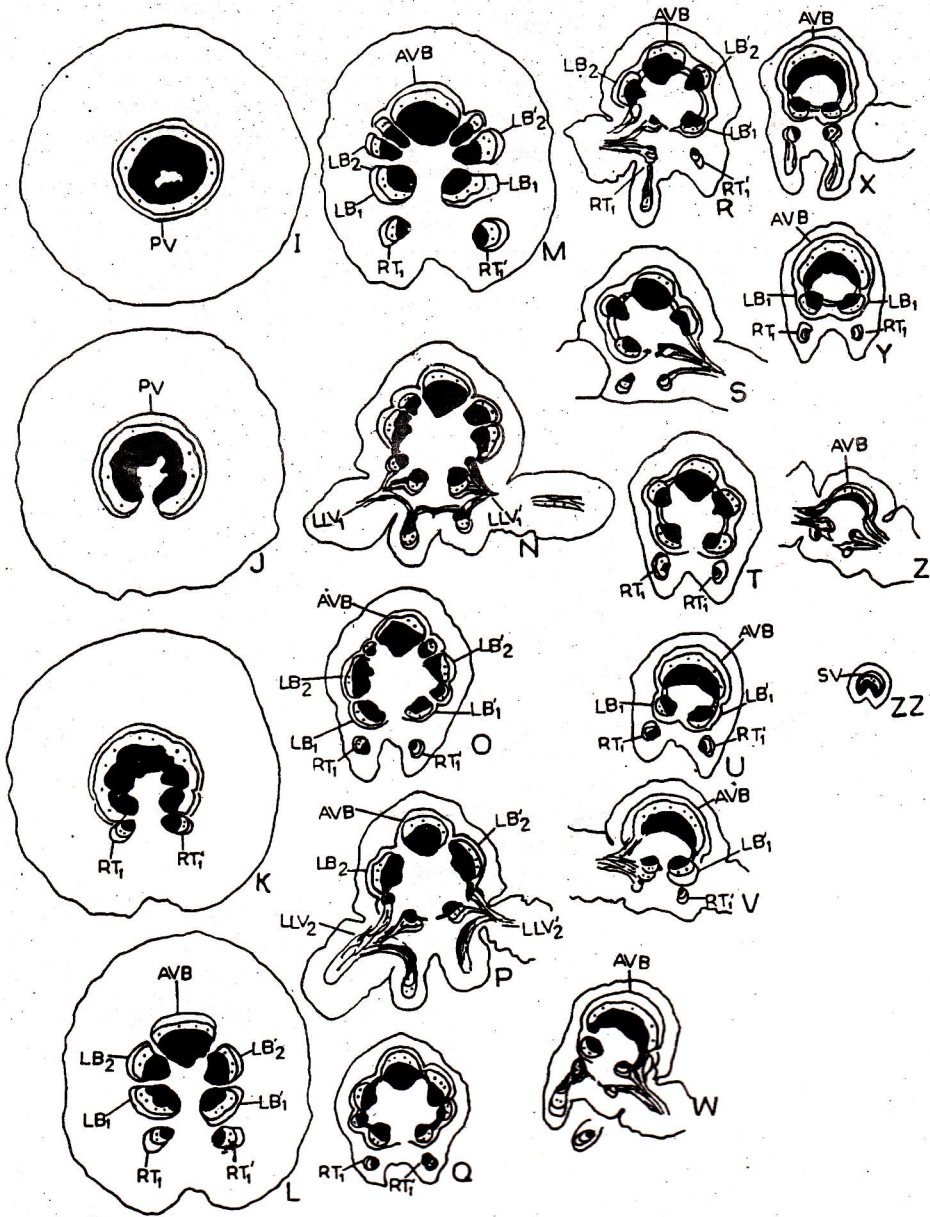
Fig. 18-19. Preparation and departure of vasculature to the last pair of leaf lets. x 100

Fig. 20-21. Spinule vasculature. x 50.

(AVB - Abaxial vascular bundle; LB<sub>1</sub> and LB<sub>2</sub> - Lateral bundles; RT<sub>1</sub> and RT<sub>1</sub>' - Ridges bundles; S - Spinule; SV - Spinule vasculature.)



**Figs. 22A-H.** Outline diagrams of transverse sections of internode, node and petiole. ABB - Abaxial bundles; ABV - Axillary bud vasculature; ADB - Adaxial bundles; LG<sub>1</sub> and LG<sub>2</sub> - Lateral gap; LT<sub>1</sub> & LT<sub>2</sub> Lateral traces; MG - Median gaps; MT - Median trace; ST - Stipular traces.)



**Figs. 22I-ZZ.** Outline diagrams of the serial transverse sections through the rachis at different levels.

(AVB - Abaixal vascular bundle; LB<sub>1</sub>, LB<sub>1</sub>', LB<sub>2</sub> and LB<sub>2</sub>' - Lateral bundles; LLV<sub>1</sub> and LLV<sub>1</sub>' - First pair leaflets vasculature; LLV<sub>2</sub> and LLV<sub>2</sub>' - Second pair leaflets vasculature; PV-Petioler vasculature; RT<sub>1</sub> and RT<sub>1</sub>' - Ridges traces; SV-Spinule vasculature.

leaflets. The rachis terminates into a spinule which is also vascularised. The rachis vasculature before entering the spinule becomes a large arcuate bundle resembling the vascular bundle of midrib of a simple leaf. This may indicate the derivation of the paripinnate leaf from an original imparipinnate condition.

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