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An Approach to the study of vessels climber species

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ABSTRACT

The angiosperms are characterized by vessels in wood, and therefore, vessel elements were selected to study them in climber species. Xylem is the specialized tissue that transports water and nutrients from the plant–soil interface to stem and leaves and provides mechanical support and storage. Water is the primary solvent for plant nutrition and metabolism and is essential for photosynthesis, turgor and for transport of minerals, hormones and other molecules. Studies on vessels showed that the characters of vessels can throw some light on the phylogeny of species. The short vessel members with many perforation plates with a single large perforation are most specialized and those that were long with elongate obliquely placed perforation plates with many perforations separated by bars that together give a scalariform appearance are primitive. The degree of specialization of vessel elements can be measured in terms of vessel length, breadth and the number of bars on the end plate of vessels. Vessels show highly evolved and primitive vessel elements. Mostly elongated vessel elements are present in middle region of the stem. During this study the broadest vessels were found in the middle part of the stem of dicots (*Clitoria, Daemia* and *Aristolochia*) and root of the monocots (*Gloriosa*) and the narrowest vessel elements were found in different parts of the species investigated. The present work is supported with line drawings of prepared stained sections, provides a framework of the vessels. This study will be very useful to a wideseries of community, who work with plants.

Figures : 53 References : 19 Table : 01

KEY WORDS : *Aristolochia,* Climbers,*Clitoria*, *Daemia, Gloriosa,* Vessels.

Introduction

The climbers are one of the specialized groups of Angiosperms showing significant evolutionary tendencies in the climbing pattern, leaf type, pistil type and morphology, asymmetry and reduction in floral whorls. The water conducting function of xylem is one of the major distinguishing features of vascular plants.

An advanced group of plant kingdom, Angiosperms shows a great assortment in habit, such as, herbs, shrubs, trees and climbers. The climbers are one of the specialized groups of Angiosperms consisting of about ca. 302 genera and ca. 1582 species belonging to ca. 52 families[16]. Botanically, plants having special structure to climb for support are defined as climber. Another type of climbing plants grow spirally around another plant or support, are known as twiners. Creepers cannot grow vertically on their own *e.g.* morning glory. All these types of plants are commonly known as climbers[5,6]. They are well established in temperate, tropical and sub-tropical regions of the globe. The climbers are extremely note worthy ornamental plants and enhance the attractiveness of the garden by attentively planting them in an appropriate site. The group is showing significant evolutionary tendencies in the climbing pattern, leaf type, pistil type and morphology, asymmetry and reduction in floral whorls. However, the literature available indicates that most of the studies in climbing plants are carried out for the beautification of gardens. Very fragmentary work is available on the anatomy particularly vessels in the climber species[14,15,19]. The climbing plants selected for the present study on vessels from stem and roots are *Clitoriaternatea*Linn. (Fam. Fabaceae), *Daemiaextensa*R. Br. (Fam. Asclepiadaceae), *Aristolochia bracteata* Retz. (Fam. Aristolochiaceae) and *Gloriosasuperba* Linn. (Fam. Liliaceae). These plants have constant familial position in different systems of classification of spermatophytes[3,4,13,17]. These species have great status in medicine and show diversity in phylotaxy, twining pattern, phenology, reproduction and beautification. Xylem is the specialized tissue of vascular plants that transports water and nutrients from the plant–soil interface to stem and leaves, and provides mechanical support and storage. The water conducting function of xylem is one of the major distinguishing features of vascular plants. The angiosperms are characterized by vessels in wood and therefore, vessel elements were selected to study them in climber species.Due to all these considerations, the

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TABLE-1: Measurement of Vessels.

Sr. No.	Name of the species	Organ	Values	Basal region L x B µ	Middle region L x B µ	Apicalregion L x B µ
1	*Clitoria ternatea*	Stem	Min.	98.4x13.6	163.6 x 49.2	22.6 x 15.6
			Max.	379.6x176.4	670.4 x 226.4	663.6 x 140.4
			Ave.	153.7x121.4	275.6 x 144.9	310.1 x 79
		Root	Min.	100.4x12.8	—	—
			Max.	210.x133.6	—	—
			Ave.	157x95	—	—
2	*Daemia extensa*	Stem	Min.	111.2x86.	164.8 x 89.2	165.2 x 53.6
			Max.	436.4x224.	386.8 x 248.4	347.2 x 196
			Ave.	252.1x159.5	296.1 x 166.1	220.3 x 130.7
		Root	Min.	204.4x50	—	—
			Max.	441.2x234	—	—
			Ave.	306.1x133.2	—	—
3	*Aristolochia bracteata*	Stem	Min.	—	101.2 x 45.2	—
			Max.	—	348 x 121.6	—
			Ave.	—	186.9 x 74.9	—
		Rhizome	Min.	—	90.4 x 58.4	—
			Max.	—	381.6 x 123.6	—
			Ave.	—	208.7 x 103.4	—
4	*Gloriosa superba*	Root	Min.	67.2x29.6	—	—
			Max.	190.8x110	—	—
			Ave.	131.2x73.7	—	—
		Stem	Min.	45.3x284	5880 x 332	5388 x 452
			Max.	12396x736	16848 x 560	14420 x 720
			Ave.	8324.8x583.6	14791.6 x 478.8	8553.6 x 583.2
		Rhizome	Min.	—	609.6 x 30.4	—
			Max.	—	2939.2 x 70.4	—
			Ave.	—	1665.6 x 52	—
		Root	Min.	1388x36.8	—	—
			Max.	3976 x 152.	—	—
			Ave.	2813.6x85.5	—	—

Min. = Minimum, Max. = Maximum , Ave. = Average

studies were carried out to know the xylem element, vessels in stem, rhizome and roots of afore mentioned species.

Materials and Methods

The present work is based on the material collected from different localities of Ahmednagar and identified by available literature[12,16]. To study vessels, stem, rhizome and roots were macerated in Jeffery's maceration fluid, varying the concentration of chromic acid (5-10%) and nitric acid (5-10%) according to the hardness of the material. Macerated material was thoroughly washed with tap water, stained with 2% aqueous safranin and mounted in glycerine jelly and then sealed with paraffin wax. To avoid destaining of the vessels little safranin was added in glycerine jelly. The comparative account of length and breadth of vessel elements are shown in Table 1. Drawings for vessels were made with the help of Leitz's camera lucida at the stage level and their measurement was made with Letz'soknor micrometer. The original Figures were suitably reduced to this page size (Plate- I).

Observations

The xylem elements, vessels, tracheids, fibers and parenchyma provide an internal hydrophobic surface facilitating water transport as well as mechanical strength. The xylem cells also support the weight of the water transported upward in the plant and the weight of the plant itself. For many trees, xylem is wood, which has been an essential raw material for human societies since antiquity, providing structural material, fuel and fiber. The angiosperms are characterized by vessels in wood, and therefore, vessel elements were selected to study its diversity in climber species.

The xylem occupies a unique position among the plant tissues wherein its anatomy plays an important role with reference to taxonomy and phylogeny. The lines of specialization of the various structural features have been better established for the xylem rather than for any other single tissue[14]. Many examples have been cited in the use of xylem anatomy to clarify taxonomic affinities[1, 18]. Extensive comparative studies have properly evaluated the variations in the morphology of the tracheary elements and explained their significance[2, 10,11].

Studies on vessels have shown that the characters of vessels can throw some light on the phylogeny of species. As per observations available short vessel members with many perforation plates with a single large perforation are most specialized and those that are long with elongate obliquely placed perforation plates with many perforations separated by bars that together give a scalariform appearance are primitive. The degree of specialization of vessel elements can be measured in terms of vessel length, breadth and the number of bars on the end plate of vessels[7,8,9,11].

The present study deals with the vessel elements in climbing species such as, *C. ternatea*, *D. extensa* , *A. bracteata* and *G. superba*. Based on these observations an attempt has been made to see how far the trend of specialization of vessel elements follows the general pattern described by others, in the plants studied here.

1. ***Clitoria ternatea*** : Basal part of the stem shows variety of forms of vessel elements, some are quite small and others are broad (Fig. 10). Mostly vessel elements are short and broader, barrel–shaped with or without pitted tail. The perforations are simple and restricted to the end walls. They measure 153.7x 121.4µ. The pits are small and mostly arranged in a definite pattern (Figs. 5-12).

The vessel elements of middle region are of varied size and shape. Some vessel elements are very broad, narrower, elongated and others are smaller and vertically elongated and or dumb-bell- shaped. They measure 275.6x144.9µ (Figs. 13-18).

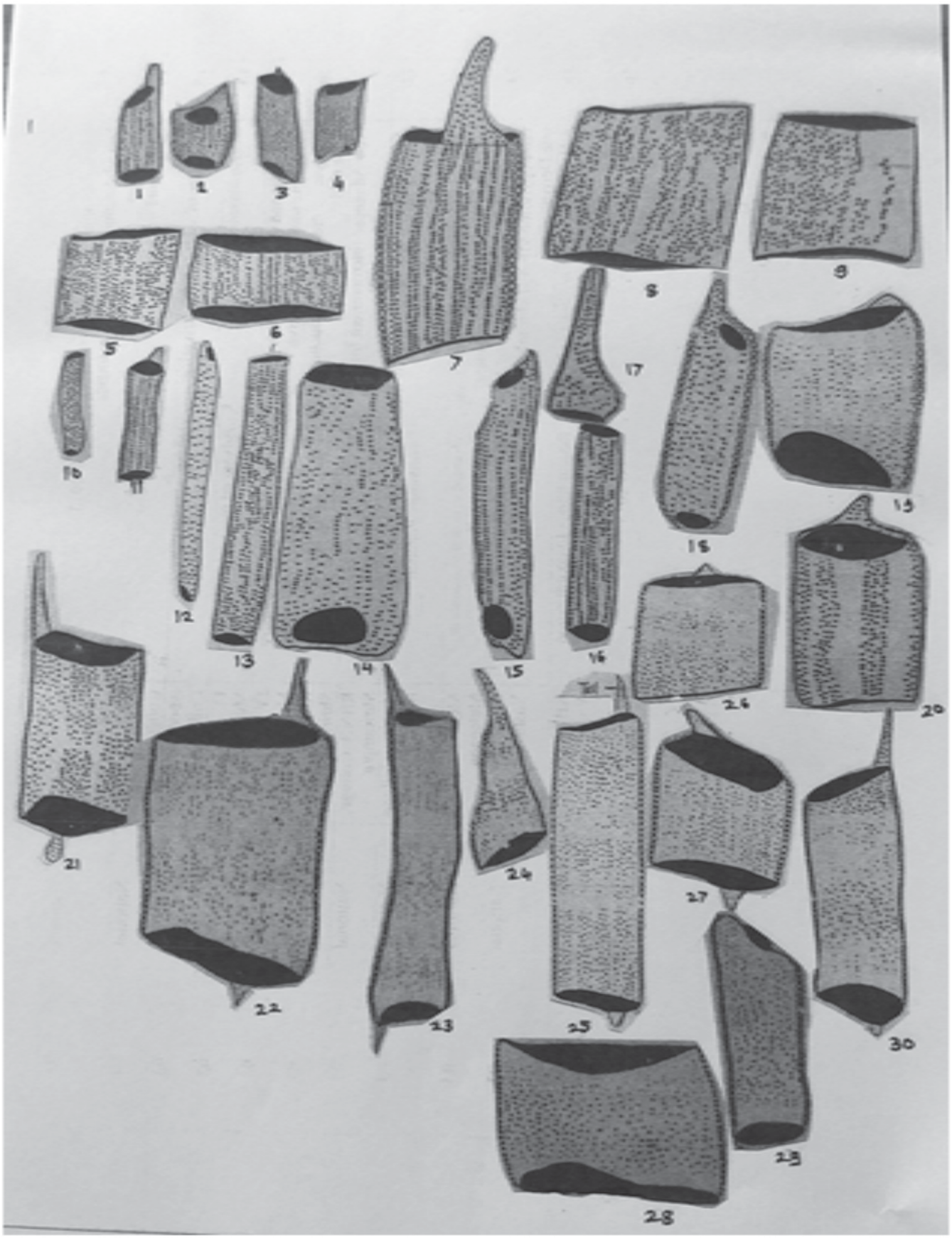
The vessels of apical region are usually elongated but smaller than the vessels from middle part. Their average length and breadth is 310.1x79µ. The perforations are restricted to the end walls as well as on the side walls of the vessel element. Only few vessel elements are with reduced pitted tails. Some vessel elements are quite smaller and are broader (Figs. 19-20).

The vessel elements in root are shorter as well as longer and narrow with transverse or oblique perforation plates. Side wall pitting is simple, arranged mostly in regular vertical rows. Their average length and breadth is 157x95µ. Pitted tail is observed in some vessel elements (Figs. 1-4).

2. ***Daemia extensa*** : The vessel elements of basal part of stem are small to elongate with or without well pitted tail, showing perforation plates, mostly horizontal or rarely oblique. Vessel elements range from small, medium to large. Small ones are uniformly elongated with tail or larger in size without tail. The pattern of pitting is simple. The average length and breadth is 111.2x86µ (Figs. 25-27).

The vessel elements of middle region are broad, drum-shaped, showing transition in between longer and shorter. The pits are numerous, small and scattered. The perforations are restricted to the end walls. The end walls are with prominent narrow or broad pitted tails (Fig. 28). The lateral wall pitting is simple and alternate, sometimes few in groups. The average length and breadth is 296.1x166.1µ (Fig. 29).

The vessel elements of the apical region are intermediate in between middle and basal parts of the stem. They measure 220.3x130.7µ. The nature of perforation plate and pitting is as above (Fig. 30).



Vessels in Climber species

Clitoria ternatea **Figs. 1 to 20 (300-550X[1]),** ***Daemia extensa***

Figs. 21 to 30(300X[1]) {X[1]Original magnification}. ***Aristolochia bracteata***

The vessel elements in root are different from that of the stem in their size and shape. They are short or long, few are distantly short and broad. The perforations are transverse as well as oblique, small and broad. Wall pitting is simple and irregular.Their average length and breadth is 306.1x133.2µ. Broad and hook like pitted tail is seen in some elements (Figs. 21-24).

3. ***Aristolochia bracteata*** : Vessels in stem are broad and drum-shaped. They possess numerous pits. These pits are simple, scattered or arranged in definite patterns. The perforations are restricted to the end walls as well as side walls of the vessel element. The end walls are with prominent narrow or reduced and broad pitted tails. The late metaxylem elements are short and barrel-shaped or elongated. They measure 186.9x74.9µ (Figs. 38-40).

The vessels of rhizome are narrow and longer, broad and smaller with simple perforation at the end. Wall pitting is simple as well as broad showing points of attachment with neighboring parenchyma cells. Pitted tail is present or reduced totally. The average length and breadth of vessel is 208.7x103.4µ. Observations indicate that vessels in the rhizome are larger and longer than the vessels of the stem and root (Figs. 35-37).

The vessel elements of root are shorter and broader without tail or elongated vertically with pitted tails. Simple, alternate and oval pits are present on the vessel elements. They measure 131.2x73.7µ (Figs. 31-34).

4. ***Gloriosa superba*** : The vessel elements of basal region of the stem are long measuring 12396x736µ. The end plates are highly oblique and have many bars on them. The number of bars varies from 26 to 31. Fusion and division of bars were noticed. There are 4-7 irregular rows of pits. The pitting is scalariform (Figs. 47-48).

The vessel elements of middle region of the stem are longer, measuring 14791.6x478.8µ. The end plates are highly oblique and have 4-7 rows of pits on them. The number of bars varies from 24-32. Fusion and division of bars were noticed. The pitting is scalari form (Figs. 49-51).

The vessels of apex region of stem are elongated but smaller than middle part measuring 8553.6x583.2µ. The end plates are highly oblique and have 4-7 rows of pits. The number of bars varies from 21-37. Fusion and division of bars were noticed. The pitting is scalari form (Figs. 52-53).

The vessel elements of the rhizome are smaller than the vessel elements from root and stem having oblique perforation. Some vessels have tapering end plates and are irregular in shape. The tip of element is acute and elongated. The pitting is scalariform showing no distinct rows of pits. The average length and breadth is 166.2x52µ (Figs. 44-46).

The vessels in root are elongated similar to stem but their perforation plates are not well defined. The pitting on vessels is scalari form with broad or acute tip. The average length and breadth is 2813.6 x 85.5µ *i.e.* the elements are smaller than the vessel elements from the stem, but are larger than vessel elements of rhizome (Figs. 41-43).

Results and Discussion

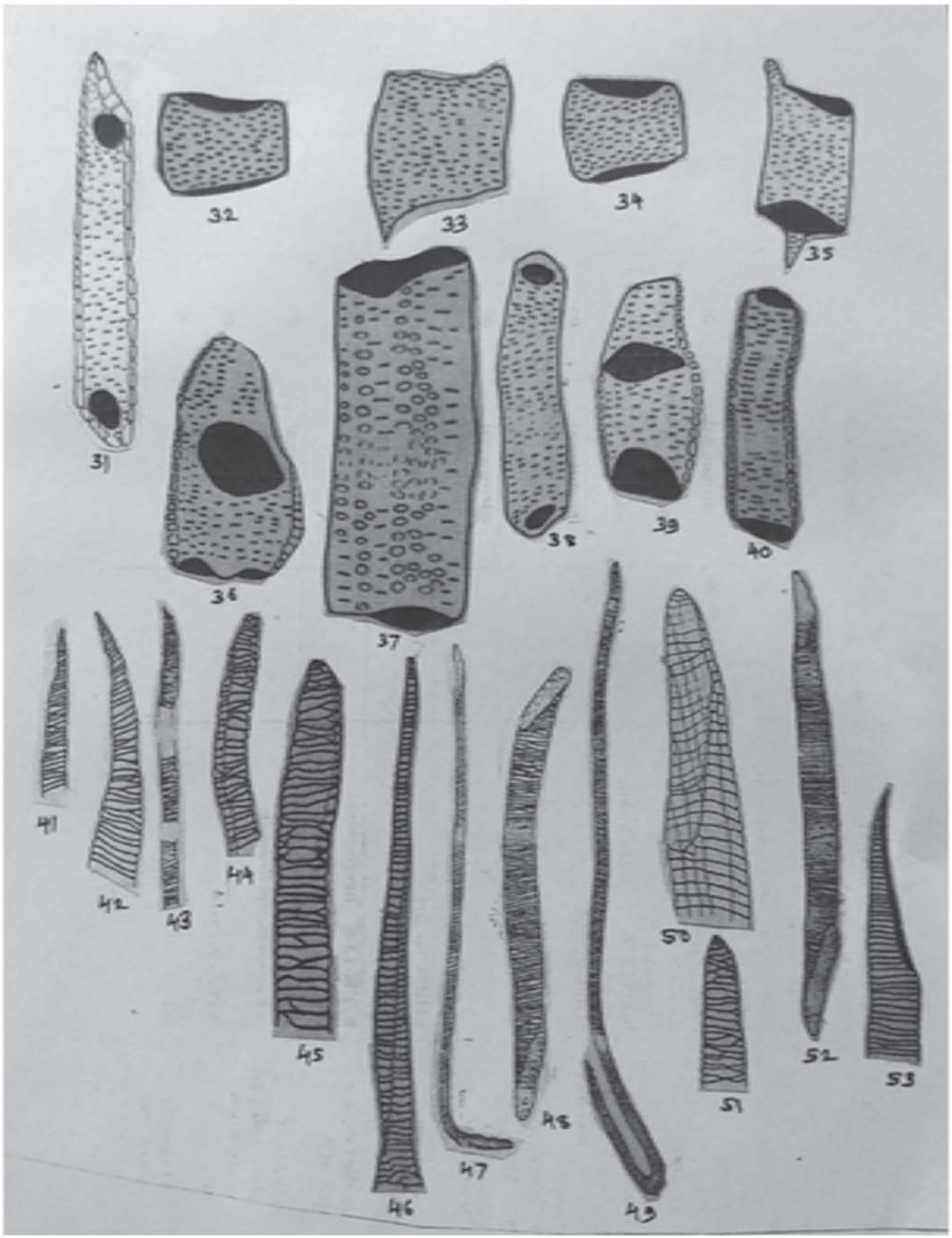
The data obtained from the critical observations, clear that, in the climbers the vessels are elongated with an oblique perforation plates. The presence of tapering or flattened tails with distinct pitting is an interesting feature of the climbers. The perforations on the side walls of the stem vessels is a peculiar character of tree habit, but presence of pitted wall is indicating its climber nature. In the present study of perforations, on the side wall as well as oblique on the ends of the vessel elements, with or without tail seems to be a distinct character.

The study clears that primitive type of vessel elements are mostly present in the basal region of the stem. However, the evolutionary steps are seen from that of the middle region of the stem showing smaller and elongated vessels. The shortest and highest specialized vessel elements are observed in the roots, where the vessels are shortest in length having considerable width, but still relating the pitted tail. This supports earlier views[1,9] for the climbers such as *Clitoria ternatea*, *Aristolochia bracteata* and *Gloriosa superba* But in *Daemia extensa* the reports are some what different; the short and broad vessel elements are present in root and apical region of the stem with pitted tails.

If a single feature of vessel element, such as, length taken into consideration, it shows that,

1. In *Clitoria ternatea* longest vessel elements are present in middle region of stem and shorter in the root.
2. In *Daemia extensa* longest vessel elements are present in root and basal region of stem and shorter into the apex of stem.
3. In *Aristolochia bracteata* the shorter vessel elements are present in the root, intermediate into the stem and longer into the rhizome.
4. In *Gloriosa superba* shorter vessel elements are present into the rhizome and root and elongated or longer into the middle region of stem.

Thus data show that vessel elements of root are short and broad (*Daemia*) or elongates, narrow (*Clitoria*) with simple, reduced or hook like pitted tail (*Daemia*) and perforation plates, transverse or oblique (*Clitoria*). Vessel elements are short, broad, drum-shaped and narrow in



Vessels in Climber species

Fig. 31 to 40 : (300-550X[1]) , *Gloriosa superba*

Fig. 41 to 53 : (24-550X[1]) {X[1]Original magnification}.

stem and elongated, broad and smaller in rhizome. In roots, vessel elements are specialized, shorter and broader, without tail and are pitted. Pits are simple, oval and alternate.

The present work concludes that, vessels show highly evolved and primitive vessel elements. Mostly elongated vessel elements are present in middle region of the stem. The studies clear that there is no definite co-relation between length and breadth of the vessel elements. The broadest vessels are generally found in the middle part of the stem of dicots and root of the monocots (*Gloriosa*) and the narrowest vessel elements are found in different parts of the climbers studied.

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