VESSEL ELEMENTS IN PERICARP OF SOME MIMOSACEAE

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ABSTRACT

Vessel elements in the basal and sutural regions of the pericarp of 15 species belonging to 11 genera of Mimosaceae are described. The shape and size of the vessel elements are variable in different regions of a pericarp in the same species and in pericarps of different species. The vessel elements of the investigated taxa belong to classes A, B, C and D of RADFORD *et al.* (1974). Perforation plates are simple (very rarely scalariform) with variable number, position and shape. Reticulate type is observed only in *Prosopis cineraria*. Most of the vessel elements are provided with a long or short tails.

INTRODUCTION

Considerable literature is now available on the vessel elements in the vegetative parts of monocotyledons but there is little information available about them in the pericarps of any family including Mimosaceae. Therefore, the present investigation was undertaken for vessel elements in the basal and sutural regions of the pericarp of 15 species of Mimosaceae.

MATERIAL AND METHOD

The mature pods of various species (Table 1) were collected from Vallabh Vidyanagar and its surroundings. They were fixed in FAA (JOHANSEN, 1940). The pieces from dorsal sutural region, ventral sutural region and basal region of the pericarps of different species were macerated (JANE, 1956) and stained with Delafield's haematoxylin after thorough washing in water, and mounted in glycerine.

OBSERVATION

Shape—Vessel elements may be narrowly or broadly cylindrical (Figs. 1-6), rhomboidal (Fig. 7), long or short spindle-shaped (Figs. 8, 9), falcately spindle-shaped (Fig. 10), trapezoidal (Fig. 11), angular (Fig. 12), angular-conical (Fig. 13), short or long conical (Figs. 14-16), conical falcate (Fig. 17), wedge-shaped (Figs. 18, 19), narrowly or broadly fusiform (Figs. 20-22), 'S'-shaped (Fig. 23), cylindric-falcate (Figs. 24, 25), curved cylindric-lanceolate (Fig. 26), ovate-cylindric (Fig. 27), elliptic-lanceolate (Fig. 28), clavate (Fig. 29), linear (Figs. 30, 31), linear-lanceolate (Figs. 32, 33), linear-cylindric straight (Fig. 34), lanceolate (Figs. 35, 36), lanceolate with one wall wavy (Fig. 37), linear-falcate (Fig. 38), bone-shaped (Figs. 39, 40), crescentic (Fig. 41), campanulate (Fig. 42), barrel-shaped (Figs. 43, 44) or bottle-shaped (Fig. 45). The most frequent shape being cylindric in basal, dorsal and ventral sutural regions.

From table 1, the following observations are made :

Size—It varies from region to region and also within the same region. In general, the vessel elements are longer in dorsal sutural region than those in the basal and ventral sutural regions. The average longest vessel elements (370.3 μm) are in in the dorsal sutural region of *Adenanthera pavonina* and the shortest ones (125.3 μm) in

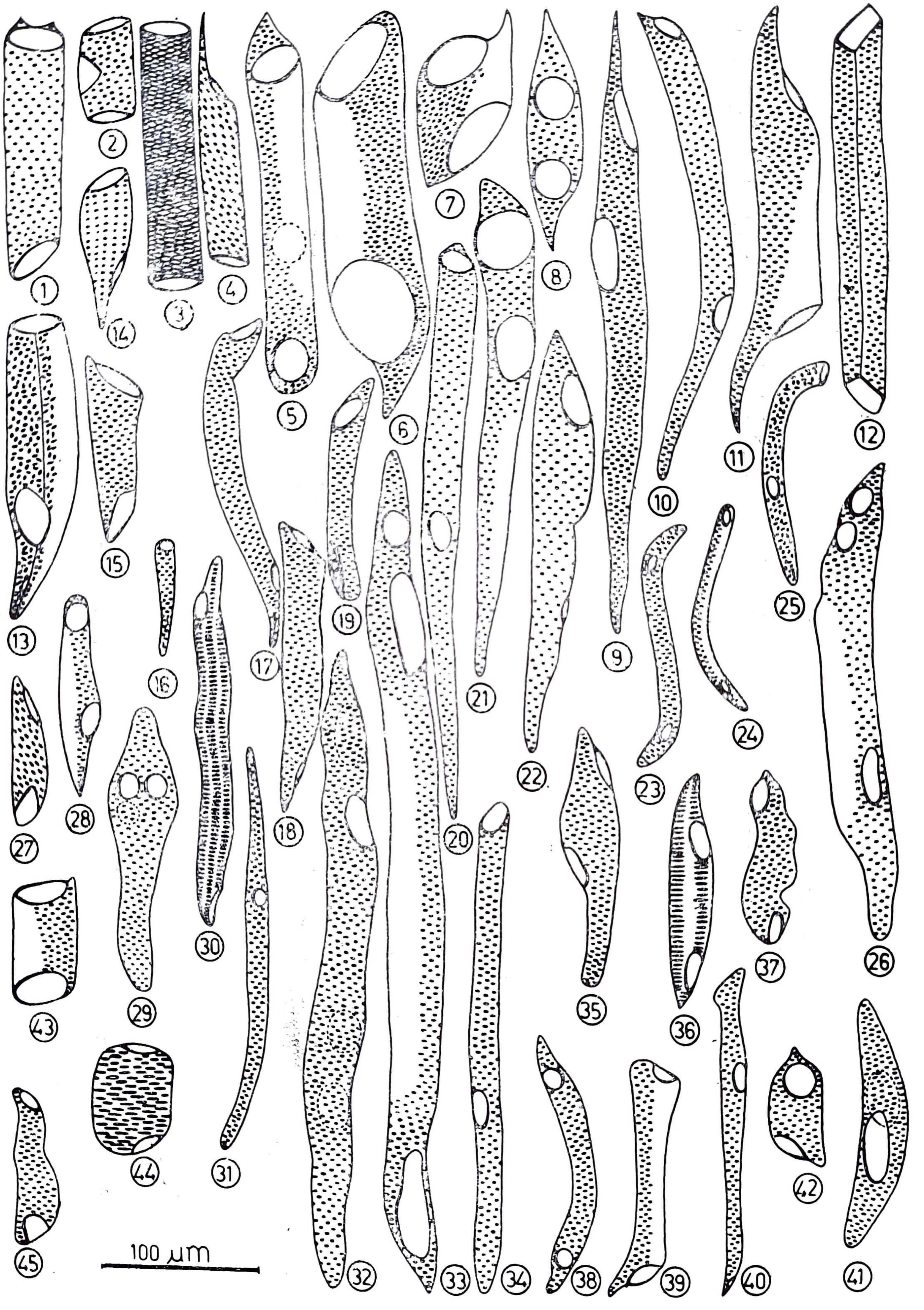
Table 1. Showing the frequency (%), size of the vessel elements in μm, number, pits on the lateral wall in the pericap of some Mimosaceae.
S—Simple, Scl—Scalariform; Ob—Oblique; L—Lateral; T—Transverse;

Sr. No.	Name of the plant	Region	Frequency of vessel elements in different classes of the classification of Radford *et al.*				Size of the vessel elements in μm	
			A (Less than 175 μm)	B (175-250 μm)	C (250-350 μm)	D (350-800 μm)	Average length	Average diameter
1.	*Acacia auriculiformis* Cav.	Basal	63.3	26.7	6.6	3.4	162.4	23.3
		Dorsal	13.3	30.0	50.0	6.6	256.3	28.8
		Ventral	70.0	23.3	3.3	3.3	169.1	12.7
2.	*A. nilotica* (L.) Del subsp. *indica* (Bth.) Brenan	Basal	96.7	—	3.3	—	125.3	25.1
		Dorsal	30.0	30.0	36.7	3.3	223.4	31.5
		Ventral	40.0	23.3	23.3	13.4	243.4	34.7
3.	*A. torta* (Roxb.) Craib.	Basal	46.7	36.7	10.0	6.6	190.8	36.0
		Dorsal	33.3	26.7	33.3	6.7	228.5	31.3
		Ventral	30.0	56.7	13.3	—	198.2	35.8
4.	*Adenanthera pavonina* L.	Basal	13.3	20.0	53.3	13.4	280.8	38.3
		Dorsal	3.3	16.7	20.0	60.0	370.3	38.6
		Ventral	26.7	36.7	33.3	3.3	226.6	36.5
5.	*Albizia lebbeck* (L.) Bth.	Basal	56.7	43.3	—	—	164.9	36.4
		Dorsal	20.0	43.3	26.7	10.0	241.1	39.2
		Ventral	26.7	36.7	33.3	3.3	226.6	36.5
6.	*Calliandra tweedii* Bth.	Basal	30.0	46.7	16.7	6.6	217.8	24.2
		Dorsal	10.0	30.0	50.0	10.0	264.3	25.3
		Ventral	33.3	40.0	23.3	3.4	221.8	22.8
7.	*Desmanthus virgatus* Willd.	Basal	73.4	13.3	13.3	—	167.3	21.8
		Dorsal	40.0	37.7	20.0	3.3	206.8	21.8
		Ventral	30.0	56.7	13.3	—	196.4	16.8
8.	*Leucaena leucocephala* (Lam.) de Wit.	Basal	3.4	23.3	53.3	20.0	299.3	36.2
		Dorsal	—	43.3	36.7	20.0	276.0	20.5
		Ventral	13.3	43.3	36.7	6.7	246.8	22.2
9.	*Mimosa hamata* Willd.	Basal	66.7	30.0	3.3	—	149.8	25.1
		Dorsal	23.3	33.3	30.0	13.4	254.6	21.6
		Ventral	23.3	36.7	13.3	6.7	241.9	23.7
10.	*M. pudica* L.	Basal	66.7	26.7	3.3	3.3	153.2	11.2
		Dorsal	45.5	31.8	18.2	4.5	198.4	10.9
		Ventral	33.3	36.7	23.3	6.7	222.2	23.5
11.	*Neptunia oleracea* Lour.	Basal	13.3	16.7	53.3	16.7	291.6	25.3
		Dorsal	3.3	36.7	53.3	6.7	267.7	22.4
		Ventral	13.3	43.3	30.0	13.4	273.0	25.2
12.	*Pithecellobium dulce* (Roxb.) Bth.	Basal	100.0	—	—	—	163.9	33.6
		Dorsal	20.0	70.0	3.3	6.7	248.7	32.1
		Ventral	40.0	23.3	300.	6.7	241.7	34.5
13.	*Prosopis cineraria* (L.) Druce	Basal	70.0	20.0	10.0	—	182.7	25.5
		Dorsal	23.3	20.7	46.7	3.3	264.8	29.9
		Ventral	16.7	40.0	40.0	3.3	239.2	27.5
14.	*Prosopis juliflora* (SW.) DC.	Basal	53.3	26.7	16.7	3.3	182.7	25.5
		Dorsal	26.7	30.0	23.3	20.0	264.8	29.9
		Ventral	16.7	40.0	40.0	3.3	239.2	27.5
15.	*Samanea saman* (Jacq.) Merr.	Basal	73.3	26.7	—	—	142.7	29.3
		Dorsal	13.3	10.0	36.7	40.0	327.4	40.1
		Ventral	16.7	20.0	50.0	13.3	275.7	40.5

position, diameter of perforation plates and relative abundance of different types of

Rt—Reticulate, c—common, r—rare, o—occasional.

Perforation plates										Lateral wall pitting	
Nature		Number				Position			Average diameter		
S	Scl	1	2	3	4	Ob	L	T		S	Rt
c	—	r	c	—	—	c	e	o	22.1	c	—
c	—	—	c	—	—	c	r	r	28.5	c	—
c	r	—	c	—	—	o	c	r	7.4	c	—
c	—	—	c	—	—	c	—	o	28.9	c	—
c	—	—	c	—	—	c	—	r	29.2	c	—
c	—	—	c	—	—	c	—	o	30.5	c	—
c	—	—	c	—	—	c	r	o	26.7	c	—
c	—	—	c	—	—	o	—	c	23.8	c	—
c	—	—	c	o	—	o	—	c	27.5	c	—
c	—	—	c	o	r	e	o	—	50.2	c	—
c	—	—	c	o	—	c	r	—	43.7	c	—
c	—	—	c	—	—	c	—	o	30.1	c	—
c	—	—	c	—	—	c	—	o	36.8	c	—
c	—	—	c	—	—	c	—	o	34.4	c	—
c	—	—	c	—	—	c	—	o	30.1	c	—
c	—	—	c	—	—	c	—	—	26.4	c	—
c	—	—	c	—	—	c	—	—	25.9	c	—
c	—	—	c	—	—	c	r	o	22.1	c	—
c	—	—	c	—	—	c	r	o	18.2	c	—
c	—	—	c	—	—	c	c	—	20.1	c	—
c	—	—	c	—	—	c	—	o	14.9	c	—
c	—	—	c	—	—	c	—	r	36.9	c	—
c	—	—	c	—	—	c	—	o	23.6	c	—
c	r	—	c	—	—	c	—	r	23.6	c	—
c	—	—	c	—	—	o	r	c	22.5	c	—
c	—	—	c	—	—	o	—	c	20.0	c	—
c	—	—	c	—	—	c	—	c	23.1	c	—
c	—	r	c	—	—	c	r	—	10.6	c	—
c	—	—	c	—	—	c	—	r	11.8	c	—
c	—	—	c	—	—	c	—	o	22.7	c	—
c	—	—	c	—	—	c	—	o	26.0	c	—
c	—	—	c	—	—	c	o	r	26.2	c	—
c	—	—	c	—	—	c	r	o	21.7	c	—
c	—	—	c	—	—	c	r	r	21.1	c	—
c	—	—	c	—	—	c	—	r	23.7	c	—
c	—	—	c	—	—	c	—	r	26.5	c	—
c	—	—	c	—	—	c	r	o	30.5	c	—
c	—	—	c	—	—	c	—	r	29.8	c	r
c	—	—	c	—	—	c	—	r	33.6	c	—
c	—	—	c	—	—	c	o	o	22.7	c	—
c	—	—	c	—	—	c	r	o	27.9	c	—
c	—	—	c	—	—	c	r	o	26.4	c	—
c	—	—	c	—	—	c	—	r	27.2	c	—
c	—	—	c	—	—	c	r	o	43.7	c	—
c	—	—	c	—	—	c	r	r	41.3	c	—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the basal region of *Acacia nilotica*. Similarly, the average broadest vessel elements are in the ventral sutural region of *Samanea saman* (40.5 μm) and the narrowest ones in the dorsal sutural region of *Mimosa pudica* (10.9 μm).

The maximum length of the vessel elements is in the basal region of *Leucaena leucocephala* (552.4 μm), and dorsal (686.8 μm) and ventral sutural regions (768.9 μm) of *Adenanthera pavonina*, but the shortest ones are in the basal region (50.8 μm), dorsal (71.7 μm) and ventral sutural region (67.2 μm) of *Pithecellobium dulce*, *Mimosa pudica* and *Acacia torta*, respectively. Similarly, the broadest vessel elements are found in the basal (61.2 μm), dorsal (67.2 μm) and ventral sutural region (71.7 μm) of *Samanea saman*, but the narrowest ones (7.5 μm) are in the basal and dorsal sutural region of *Mimosa hamata* and in the ventral sutural region of *Acacia auriculiformis*.

Classification of Vessel Elements

It is evident that the vessel elements in basal, dorsal and ventral sutural regions of most of the investigated taxa of Mimosaceae spread over to classes A, B, C and D of Radford *et al.* (1974), with a few exceptions, e. g. class D is absent in the basal regions of *Mimosa hamata*, *Prosopis cineraria* and in the ventral sutural region of *Acacia torta*, class A in dorsal sutural region of *Leucaena leucocephala*, class D in basal and ventral sutural regions of *Desmanthus virgatus*, class B and D in the basal region of *Acacia nilotica*, classes C and D in the basal region of *Albizia lebbeck* and *Samanea saman*.

Class A makes up the highest percentage in most of the species class C in, *Adenanthera*, *Leucaena* and *Neptunia* and class B in *Calliandra* in the basal region. In the dorsal sutural region it is class A in *Acacia auriculiformis* and *A. nilotica*, class D in *Adenanthera pavonina* and *Samanea saman* and classes A and C in *Acacia torta* with equal percentages and among the rest of the species half of the species have class B and half have class C with highest percentage. In ventral sutural region the highest percentage of vessel elements in most of the species belong to class B, but in *Acacia auriculiformis*, *A. nilotica* and *Pithecellobium dulce* they belong to class A, in *Prosopis juliflora* and *Samanea saman* to class C, in *Adenanthera pavonina* to class D and in *Prosopis cineraria* to classes B and C with equal percentages

Perforation plates—The perforation plates are simple (Figs. 1-45) in all species except in the ventral sutural regions of *Acacia auriculiformis* and *Leucaena leucocephala* where they are scalariform (Fig. 19). The number of perforation plates to a vessel element is commonly two (Figs. 1, 3, 4, 6-15, 17-25, 27, 28, 30, 34-45), but occasionally three (Figs. 2, 26, 29, 33), rarely one (Figs. 16, 31) and very rarely four (Fig. 32). The position of perforation plates is more commonly oblique (Figs. 1, 4-7, 9-12, 15, 17-19, 22, 26, 27, 35-37, 39, 42, 44, 45), occasionally lateral (Figs. 2, 5, 8-10, 13, 17, 20-26, 28-34, 38, 40-42), but seldom transverse (Figs. 1-4, 13, 16, 20, 25, 43,

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Figs. 1, 3 11, 20, 25, 26, 36—Dorsal sutural vessel elements 1, 20—*Acacia nilotica*; 3, 36—*Prosopis cineraria*; 11—*Albizia lebbeck*; 25—*Desmanthus virgatus*; 26—*Adenanthera pavonina*.

Figs. 2, 6, 10, 13, 19, 22-24, 27, 37, 38, 40, 42—Ventral sutural vessel elements. 2, 13—*Acacia torta*; 6—*Samanea saman*; 10—*Acacia nilotica*; 19—*Leucaena leucocephala*; 22—*Adenanthera pavonina*; 23, 24,—*Acacia auriculiformis*; 27—*Pithecellobium dulce*; 37, 42—*Mimosa pudica*; 38—*Neptunea oleracea*; 40—*Colliandra tweedi*.

Figs. 4, 7-9, 12, 14-18. 21, 28, 29, 32, 33, 41, 45—Basal vessel elements. 4, 43—*Acacia nilotica*; 7—*Samanea saman*; 8; 14—*Acacia torta*; 12, 16—*Acacia auriculiformis*; 15, 44—*Albizia lebbeck*; 17—*Desmanthus virgatus*; 18—*Leucaena leucocephala*; 9, 21, 29, 32, 33, 41—*Adenanthera pavonina*; 28, 45—*Pithecellobium dulce*; 30—*Prosopis juliflora*.

44). In addition, a few positional combinations of perforation plates are also met with. They are: (i) oblique and transverse (2.2%) (Figs. 1, 4, 44), (ii) transverse and lateral (4.6%) (Figs. 2, 13, 20, 25), (iii) oblique and lateral (20.3%) (Figs 5, 6, 9, 10, 17, 19, 22, 26, 34, 42). When there are three perforation plates, all the plates may be situated at one end of the vessel element (Fig. 29), two at one end and the other at the other end (Figs. 26, 33) or one at either end and the third in the centre (Fig. 2). The four perforation plates occur laterally in two pairs, one pair towards each end of the vessel element (Fig. 3).

The shape, diameter and position of the perforation plates are much variable in a vessel element. Most commonly the shape is circular (lenticular in side view) (Figs. 1-8, 10, 11, 13-22, 25-33, 35, 37-40, 42-45), but occasionally it is oblong (Figs. 6, 33, 37) triangular (Fig. 2), rectangular (Fig. 12) or ovate (Fig. 33). The diameter of the perforation plate may or may not be equal to the diameter of the vessel element (Table 1, cf. Figs. 13, 29). The maximum average diameter of the perforation plate is in the basal (50.2 μm), dorsal (43.7 μm) and the ventral sutural region (44.7 μm) of *Adenanthera* and the minimum in the basal region (10.6 μm) and dorsal sutural region (11.8 μm) of *Mimosa pudica* and ventral sutural region of *Acacia auriculiformis* (7.4 μm).

Lateral wall pitting—The lateral walls of the vessel elements possess simple pits. However, only reticulate thickening is observed on the lateral walls of the vessel elements in the dorsal sutural region in *Prospopis cineraria* (Fig. 3). The pits are commonly ellipsoidal, seldom transversely elongated (Figs. 30, 36, 44). Their arrangement is alternate, at times in linear rows (Figs. 14, 30, 36), rarely irregular (Fig. 13, 25). The pits are transverse, rarely oblique (Figs. 4, 7, 27).

Tails—Majority of the vessel elements end in a short (Figs. 1, 6-8, 14, 15, 18-22, 26-28, 35-39, 42, 43) or long (Figs. 4, 9-11, 13, 17, 35) spur-like projection called "tail". The average length of the tail is more in ventral sutural region (39.7 μm) than in the basal (37.4 μm) and dorsal sutural region (35.8 μm).

DISCUSSION

The present report is the first record of vessel elements in different regions of the pericarp. They broadly belong to classes, A, B, C and D of RADFORD *et al.* (1974) though in some regions of a few species where one or more of these classes are not represented.

Most of the species with highest percentage of vessel elements belong to class A in the basal region, and class B in the ventral sutural region and equally to classes B and C in dorsal sutural region. CHEADLE (1943a, b) stated that the vascular cells in the regions of nodes or near branch roots may be shorter than elsewhere. Our comparative study of vessel elements in basal, dorsal and ventral sutural regions in the pericarp of Mimosaceae shows that the basal vessel elements are shortest, ventral sutural ones shorter and those in the dorsal sutural region are longest.

According to METCALFE AND CHALK (1950), the vessel elements in the vegetative parts of Mimosaceae are typically medium-sized (100-200 μm tangential diameter) to large and largest in some species of *Albizia* and *Pithecellobium*. But our study shows that the vessel elements in the pericarp are narrower (7.5—71.7 μm) in diameter than in the vegetative parts. Further, the broadest vessel elements in the pericarp are in *Samanea saman*. The simple perforation plates reported by METCALFE AND CHALK (1950) in the family are also observed in the pericarpial vessel elements, but the scalariform perforation plate in the ventral sutural regions of *Acacia auriculiformis* and *Leucaena leucocephala* is an additional record. The information about the number, size, shape and position of perforation plates is meagre in the published literature on Mimosaceae. In the present study they vary from 1 to 4 and their positions are from oblique to lateral/transverse. The intervascular pitting is simple, alternate (see also METKALFE & CHALK, 1950), and at times linear or irregular. Reticulate thickening of the lateral wall encountered in the dorsal sutural vessel elements of *Prosopis cineraria* is not reported earlier.

The vessel elements with simple perforation plates and simple pits are highly evolved (BAILEY, 1953; BIERHORST, 1960). The pericarpial vessel elements of Mimosaceae on these counts can be so considered.

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REFERENCES

BAILEY, I. W. (1953). Evolution of tracheary tissue in Land Plants. *Am. J. Bot.*, **60** : 4-8.

BIERHORST, D. W. (1960). Observations on tracheary elements. *Phytomorphology*, **10** : 249-305.

CHEADLE, V. I. (1943a). The origin and certain trends of specialization of the vessels in the Monocotyledonae. *Am. J. Bot.*, **30** : 11-17.

CHEADLE, V. I. (1943b). Vessel specialization in the late metaxylem of the various organs in the Monocotyledoneae. *Am. J. Bot.*, **30** : 484-490.

JANE, F. W. (1956). *The structure of wood*. The Macmillan Co., New York.

JOHANSEN, D. A. (1940). *Plant Microtechnique*. New York.

METCALFE, C. R. & CHALK, L. (1950). *Anatomy of the Dicotyledons*. I. Clarendon Press, Oxford.

RADFORD, E., DICKISON, A., WILLIAM, C., MASSEY, R., BELL, J. & RITCHE, C. (1974). *Vascular plant systematics*. Happer & Row Publishers, New York.