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Anatomy of family Mimosoideae from different Geographical Areas

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Abstract

The study gives a comparatrive data of the anatomical features of some species of the family Mimosoideae. The species like Acacia catechu, Acacia nilotica, Acacia suma, Albizia amara, Albizia chinensis, Albizia lebbek, Albizia odoratissima, Albizia procera, Dichrostachys cinerae, Parkia timoriana, Pithecellobium dulce, Xylia xylocarpa have been compared as per the data collected by Luxmi Chauhan and Peter Gasson. As well as the slides collected from the National Xylarium, FRI Uviversity, Dehradun, India were analysed under the Carl Zeiss light microscope. The photomicrographs were taken for the various micro histological character and comparative range graphs were prepared for the data collected by Luxmi Chauhan and Peter Gasson. Though it is known that no variations are found in the anatomical features of the species wherever it is grown, this study reflects that growth ring character, number of vessels/ sq. mm, Inter Vessel Pits diameter, Numbers of cells/strand, fibres character is affected by the change of geographical location. This survey has shown the possibilities and limits for identification of mimosid woods.

Keywords: Mimosoideae, Anatomical features, Growth ring, Number of vessels/ sq. Mm, Inter vessel pits diameter, Numbers of cells/strand.

Introduction

"Mimosoids" the major groups of legumes and have been usually recognized as the subfamily Mimosoideae within the family Fabaceae. This consists of trees, shrubs, and lianas found Tropical, sub-tropical and warm temperate regions of the world where they serve as important sources of forage and fuel[1,2]. Mimosoids are accounted the greater diversity in tropical America, Africa and Australasia. Members of this subfamily are common in lowland tropical rainforests, especially along rivers and near lakes, but have also successfully adapted to drier savannas, scrub and thorn forests, and arid desert regions in the Americas[3,4,5] and Africa[6]. The Mimosoideae subfamily is the least numerous of the Leguminosae, according Mabberley[7] which includes about 60 genera and over 3000 species. From the economic standpoint, many commercially valuable species, either for the quality of its timber, as food or medicinal plants.

The studies on anatomy of wood of this family at the species level has been carried out by Nardi and Edlmann[8], Barajas[9] et al., and Miller and Detienne[10]. They also highlight descriptions at family or subfamily level. Baretta-Kuipers[11] and Evans, Gasson and Lewis[12] dealt with some tribes, subtribes and genera belonging to different subfamilies of the Leguminosae[13-16]. Many species of the subfamily Mimosoideae important in Indian sub-continent: from the point of view of timber, *Albizia lebbek* has been widely used in the construction industry and furniture, as emblematic trees have species are *Prosopis juliflora* (Falcon), many species of Inga are used as shade tree for crops so on and so far.

This paper describe the wood anatomy of 12 species of the subfamily Mimosoideae that grow in different parts of the world and to compare the characters through quantified anatomical data to have a broader approach not only to study different anatomical features, but also to select some important character to standardize the key for species identification. The broad anatomical characters of the steam under the study includes: Presence or absence of growth rings, number of vessels/sq. mm., Number of radial multiples, IVP diameter, clusters, fiber wall thickness, mean vessel diameter, cells/strand, parenchyma, crystals, rays/mm, ray width, ray height, rays and septate fibers.

Materials and Methods

Permanent slides of 12 species (Table-1) were studied for the micro histological character and the photomicrographs were taken under microscope (Carl Zeiss microscope) and the micro slides were exposed at 5X magnification with the help of a digital camera mounted over the microscope. Micro histological data of these species were compared with the published literature of Chauhan L[17] and Gasson P[18].

Altogether 15 covariates (both categorical, quantative and ordinal) has been taken into account for the comparative study they are: growth rings, vessels/sq. mm., radial, multiples, IVP diameter(µm), clusters, fiber wall thickness, mean vessel diameter, cells/strand, parenchyma, crystals, rays/mm

Table-1
Location of collection of sample[17,18]

Species	Luxmi Chauhan	Peter Gasson
Acacia catechu	West Bengal, Punjab, Bihar	Kangra India, Kew
Acacia nilotica	Salem,Tamilnadu, Sind(West Pakistan)	Libya, India, Sudan, Swaziland
Acacia suma	Orissa, Gujarat	Sudan, India
Albizia amara	Andhra, Karnataka, Arunachal Pradesh	Africa
Albizia chinensis	Bihar, Uttar Pradesh	Nigeria, Burma
Albizia lebbek	Punjab, Andamans, Tamil Nadu, Orissa	Burma, India, Queensland
Albizia odoratissima	West Bengal, Uttar Pradesh	India, Indo- China
Albizia procera	Andamans, West Bengal, Assam	Burma, Siam, Philippines, Andamans
Dichrostachys cinerae	Rajasthan	Swaziland, India, Uganda
Parkia timoriana	Uttar Pradesh	Indo china
Pithecellobium dulce	Tamil Nadu	Burma
Xylia xylocarpa	Karnataka Maharashtra	India, Indo- China

ray width, ray height, rays(homogenous/heterogeneous), septate fibers. Of which, 9 covariates (growth rings, vessels/sq. mm., radial multiples, IVP diameter (µm), cells/strand, parenchyma, ray height, rays, septate fibers) has been selected for comparison, rest of the 6 covariates (clusters, fiber wall thickness, mean vessel diameter, crystals, ray width, ray height) could not be analyzed due to non-comparative data available.

Results and Discussion

The permanent slides of different species of Mimosoideae were studied in detail (Table-2); the data of the slides under study are shown in Table 3. The optical micrographs of these species are shown in Figure-1 (a-l), respectively. Results are compared between the data published by Chauhan L[17] and Gasson P.[18] Most of the data were in range. But where the ranges have been compared with the available mean data, a dummy variable column has been created by duplicating the mean data for comparison, and the data were analyzed.

Growth Rings: While comparing the character of the growth ring it has been observed that the overlapped variation in this character has been observed in Acacia catechu, Albizia amara, Albizia lebbek, Albizia odoratissima, Albizia procera, Dichrostachys cinerae, and Xylia xylocarpa in the data provided by both the authors. However, major variation has been observed in Albizia chinensis and Pithecellobium dulce. But no variation has been observed in case of Acacia nilotica, Acacia suma and Parkia timoriana; even when growing in two distinct geographical regions.

Radial Multiples: Figure-2 shows the comparative ranges of radial multiples. It has been observed that the data published by Peter Gasson has a wider range than the data range published by Luxmi Chauhan except the radial multiples of Acacia suma and in case of Pithecellobium dulce and Xylia xylocarpa the range of radial multiples remain intact to 2-3 and 2-4 respectively. The data ranges of radial multiples which can be used to identify the species under study are shown in Table-4.

Number of vessels/ sq. mm: Comparative ranges of no. of vessels/ sq mm are shown in Figure-3. It has been observed that the data published by Peter Gasson and Luxmi Chauhan has a similar data range except the number of vessels/ sq. mm. of Acacia nilotica which has a considerable higher number (42) followed by number of vessels/ sq. mm. of Acacia suma (21) and Xylia xylocarpa (30); which essentially defines the effect of climate and changing geographical locations on the characteristic i.e., from Orissa, India to Sudan for Acacia suma and from Karnataka to China for Xylia xylocarpa. The data ranges of number of vessels/ sq. mm. which can be used to identify the species under study are shown in Table-5.

Table-2
Anatomical characters: radial multiples, vessels, IVP, no. of cells per strand, rays/mm, fibres

Species	Growth rings	Radial multiples (per mm^2)	Vessels (per mm^2)	IVP diameter (µm)	No. of cells per stand	rays/mm	Fibers
Acacia catechu	distinct to indistinct	2-6	9-22	5-10	1-4	4-7 homogenous	absence of septate fibers and with marginal, Vascicentric, aliform, confluent marginal bands parenchyma strand.
Acacia nilotica	indistinct	2-5	12-42	5-10	1-4	3-7 homogenous	absence of septate fibers and with Vascicentric, aliform, confluent broad parenchyma strand.
Acacia suma	distinct	2-4	5-21	3-10	1-3	5-8 homogenous	absence of septate fibers and with marginal, aliform, confluent broad parenchyma strand.
Albizia amara	distinct to indistinct	2-5	3-8	5-10	1-4	6-9 homogenous	presence of septate fibers and with marginal, diffuse aggregate, Vascicentric, aliform, axial parenchyma frequently confluent parenchyma strand.
Albizia chinensis	distinct	2-4	3-8	6-12	1-4	5-7 homogenous	absence of septate fibers and with marginal, diffuse aggregate, Vascicentric, aliform, confluent broadparenchyma strand.
Albizia lebbek	distinct to indistinct	2-5	1-6	6-12	1-5	3-8 homogenous	presence of septate fibers and with marginal, aliform, confluent broad Vascicentric, bands parenchyma strand.
Albizia odoratissima	distinct to indistinct	2-5	2-7	6-12	1-6	4-7 homogenous	presence of septate fibers and with marginal, aliform (winged) , confluent broad to confluent marginal, Vascicentric (winged), bands parenchyma strand.
Albizia procera	distinct to indistinct	2-5	1-7	6-12	1-7	5-8 homogenous	absence of septate fibers and with marginal, Vascicentric, aliform, confluent broad, rarely confluent parenchyma strand.
Dichrostachys cinerae	distinct to indistinct	2-7	10-26	6-10	1-3	5-8 homogenous	absence of septate fibers and with marginal, Vascicentric, aliform/ unilateral, occasionally axial parenchyma confluent parenchyma strand.
Parkia timoriana	indistinct	2-5	3-9	6-10	1-5	5-18 homogenous	absence of septate fibers and with marginal, aliform, confluent broad, broad banded axial, confluent marginal, Vascicentric, unilateral, occasionally axial / confluent parenchyma strand.
Pithecellobium dulce	distinct to indistinct	2-3	6-16	6-13	1-3	9-14 homogenous	presence or absence of septate fibers and with Vascicentric, aliform, parenchyma strand.
Xylia xylocarpa	distinct to indistinct	2-4	5-30	5-10	1-5	mm10-17 homogenous	absence of septate fibers and with Vascicentric to aliform confluent narrow, marginal, confluent parenchyma strand.

Table-3
Slides collected from Xylarium, FRI, Dehradun, India

Species	Slide Reference Number
Acacia catechu	625,1196,7908
Acacia nilotica	1051,1379
Acacia suma	1308,1310
Albizia amara	6033,615,8236
Albizia chinensis	8031, 862
Albizia lebbek	3560, 5200, 7372, 7832
Albizia odoratissima	2360,5313, 5941
Albizia procera	518,2361,7307, 7559
Dichrostachys cinerae	3239, 4447
Parkia timoriana	3264, 6616
Pithecellobium dulce	5124,4135
Xylia xylocarpa	1151, 4388

IVP diameter: The comparison of IVP diameter revel a wider data range of Luxmi Chauhan[17] than the data range of Peter Gasson, shown in Figure-4. The ranges are distinctively different in case of *Albizia amara, Albizia chinensis* and *Pithecellobium dulce*. This might be due to the sampling site variation. Hence, it may be concluded that geographical variation has a higher effect on the variation in IVP diameter. The data ranges of IVP diameters as per the studies are represented in Table-6.

Numbers of cells/strand: The comparison of numbers of cells/strand is shown in Figure-5. It has been observed that the data range of Luxmi Chauhan has overall overlapping with the data range of Peter Gasson. Except Albizia odoratissima in which the data ranges are distinctively different. In case of Acacia catechu, Albizia lebbek, Albizia procera, Parkia timoriana, and Pithecellobium dulce the data range of Peter Gasson is found to be wider, this may be due to the geographical variation of the sampling site.The data ranges of Numbers of cells/strand which can be used to identify the species, shown in Table-7.

Ray height: It has been observed that the data range of Peter Gasson has distinctive variation in case of Albizzia lebbek, Albizzia odoratissima, and Albizzia procera. In case of Parkia timoriana the data range of Luxmi Chauhan has wider data range.

Ray Characters: Ray character of all the species (Mimosoideae) under study is found to be homogenous.

Parenchyma character: Variations are observed in the parenchyma type of Albizzia chinensis, Albizzia procera, Dichroctachys cinerae, Parkia timoriana, Xylia xylocarpa in the data provided by Luxmi chauhan and Peter gasson.

Table-4
Anatomical character: radial multiples[17,18]

Species	Luxmi Chauhan		Peter Gasson		Composite	
	Low	High	Low	High	Low	High
Acacia catechu	2	4	2	6	2	6
Acacia nilotica	2	4	2	5	2	5
Acacia suma	2	4	2	3	2	4
Albizia amara	2	3	2	5	2	5
Albizia chinensis	2	3	3	4	2	4
Albizia lebbek	2	3	2	5	2	5
Albizia odoratissima	2	3	2	5	2	5
Albizia procera	2	3	2	5	2	5
Dichrostachys cinerae	2	4	2	7	2	7
Parkia timoriana	2	3	2	5	2	5
Pithecellobium dulce	2	3	2	3	2	3
Xylia xylocarpa	2	4	2	4	2	4

Table-5
Anatomical character: no. of vessels/mm^{2}(17,18)

Species	Luxmi Chauhan		Peter Gasson		Composite	
	Low	High	Low	High	Low	High
Acacia catechu	9	22	17	17	9	22
Acacia nilotica	12	18	42	42	12	42
Acacia suma	5	11	21	21	5	21
Albizia amara	3	8	6	6	3	8
Albizia chinensis	3	10	3	3	3	10
Albizia lebbek	1	6	3	3	1	6
Albizia odoratissima	2	7	6	6	2	7
Albizia procera	1	7	3	3	1	7
Dichrostachys cinerae	10	26	23	23	10	26
Parkia timoriana	3	9	5	5	3	9
Pithecellobium dulce	6	16	12	12	6	16
Xylia xylocarpa	5	18	30	30	5	30

Table-6
Anatomical character: IVP diameter[17,18]

Species	Luxmi Chauhan		Peter Gasson		Composite	
	Low	High	Low	High	Low	High
Acacia catechu	5	10	6	9	5	10
Acacia nilotica	5	10	6	7	5	10
Acacia suma	5	10	3	7	3	10
Albizia amara	6	12	6	6	6	12
Albizia chinensis	6	12	6	6	6	12
Albizia lebbek	6	12	6	10	6	12
Albizia odoratissima	6	12	9	12	6	12
Albizia procera	6	12	9	12	6	12
Dichrostachys cinerae	7	10	6	7	6	10
Parkia timoriana	7	10	6	10	6	10
Pithecellobium dulce	6	10	9	13	6	13
Xylia xylocarpa	5	9	6	10	5	10

Table-7
Anatomical character: no. of cells/ strand[17,18]

Species	Luxmi Chauhan		Peter Gasson		Composite	
	Low	High	Low	High	Low	High
Acacia catechu	1	2	2	4	1	4
Acacia nilotica	1	4	2	4	1	4
Acacia suma	1	3	2	3	1	3
Albizia amara	1	4	2	4	1	4
Albizia chinensis	1	4	2	4	1	4
Albizia lebbek	1	4	1	5	1	5
Albizia odoratissima	1	4	5	6	1	6
Albizia procera	1	5	2	7	1	7
Dichrostachys cinerae	1	3	1	3	1	3
Parkia timoriana	1	3	2	5	1	5
Pithecellobium dulce	1	2	1	3	1	3
Xylia xylocarpa	1	4	2	5	1	5

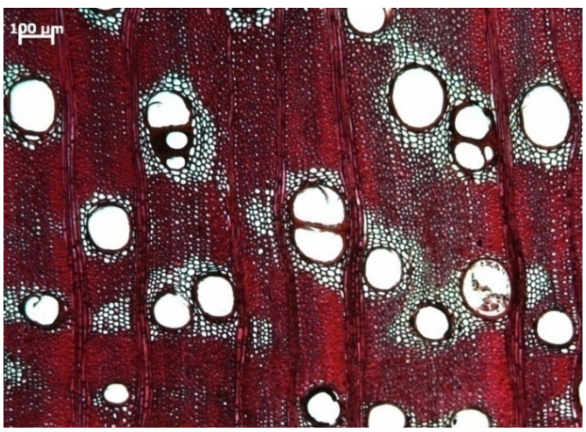

Figure-1a
Acacia arabica-1379-ts

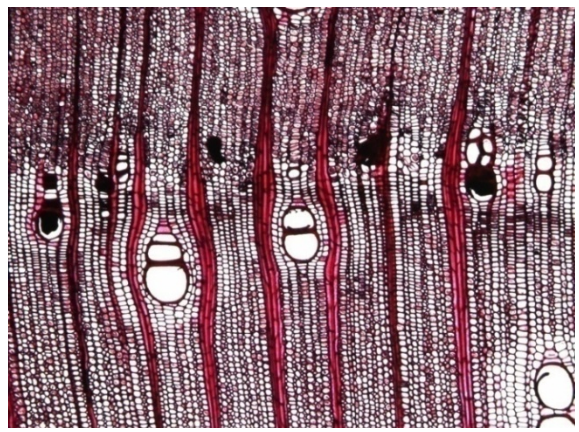

Figure-1c
Albizzia chinensis -8032 -5x-ts

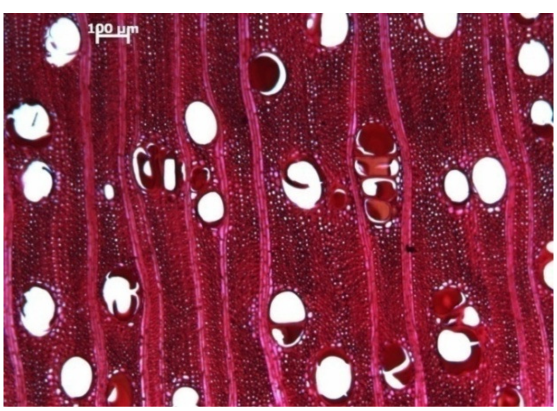

Figure-1b
Acacia suma-1310-ts-5x

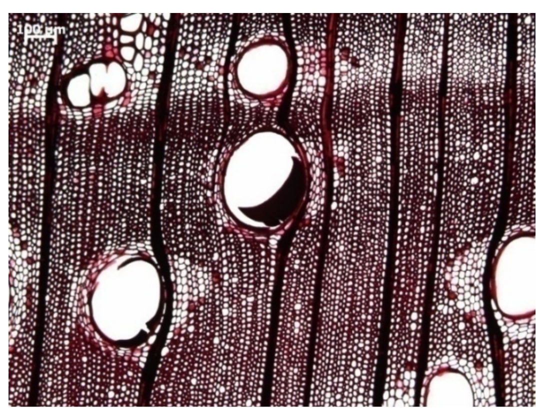

Figure-1d
Albizzia lebbek -3560-5x-ts

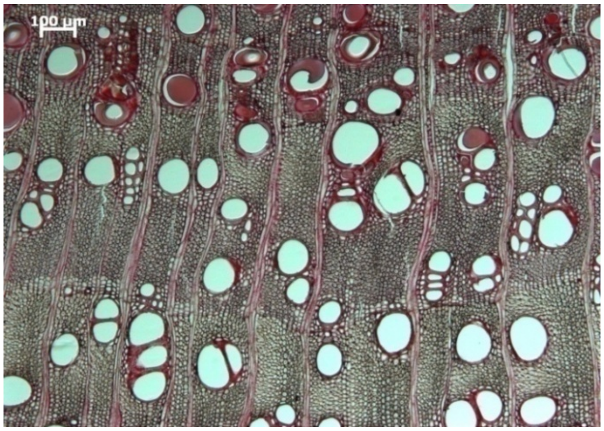

Figure-1e
Dichrostachys cinerae-3239-5x-ts

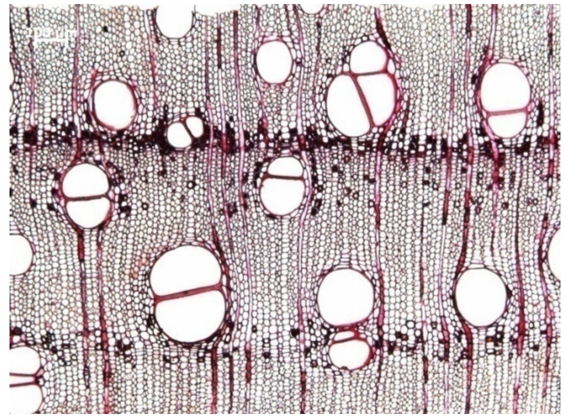

Figure-1g
Pithecellobium dulce-5075-5X-ts

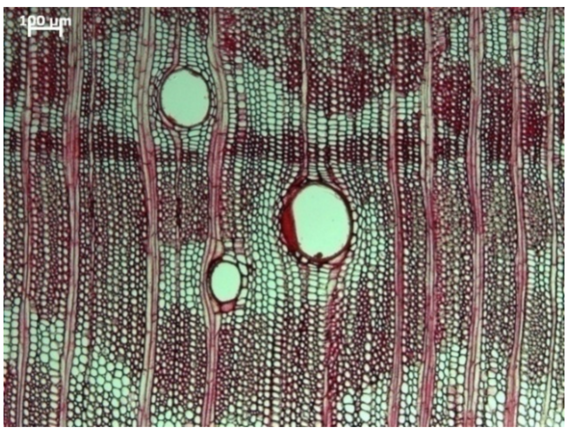

Figure-1f
Parkia timoriana-3264-5x-ts

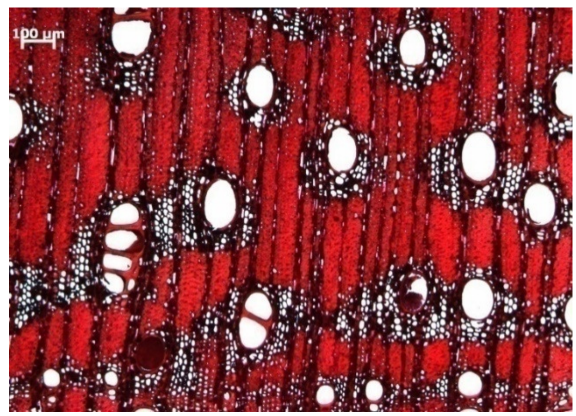

Figure-1h
Xylia xylocarpa-1151-5x-ts

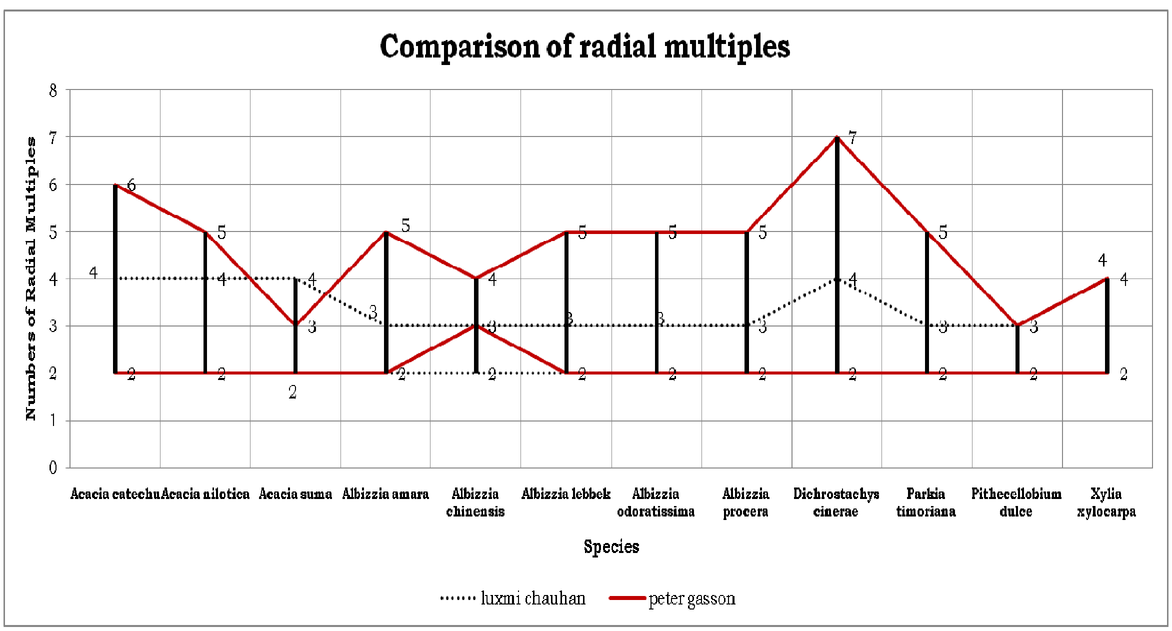

Figure-2
Comparative ranges of radial multiples

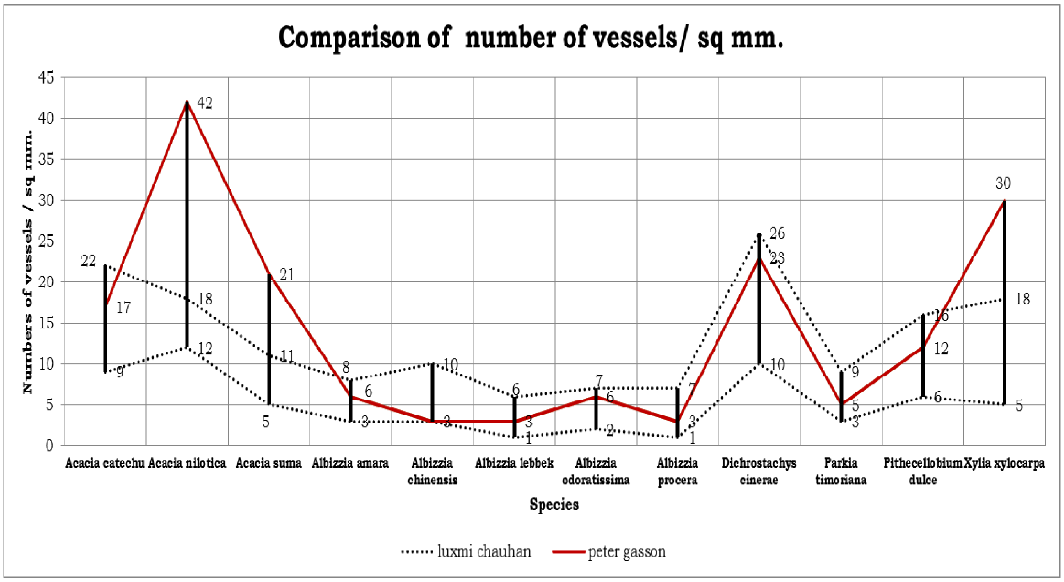

Figure-3
Comparative ranges of number of vessels/ sq mm

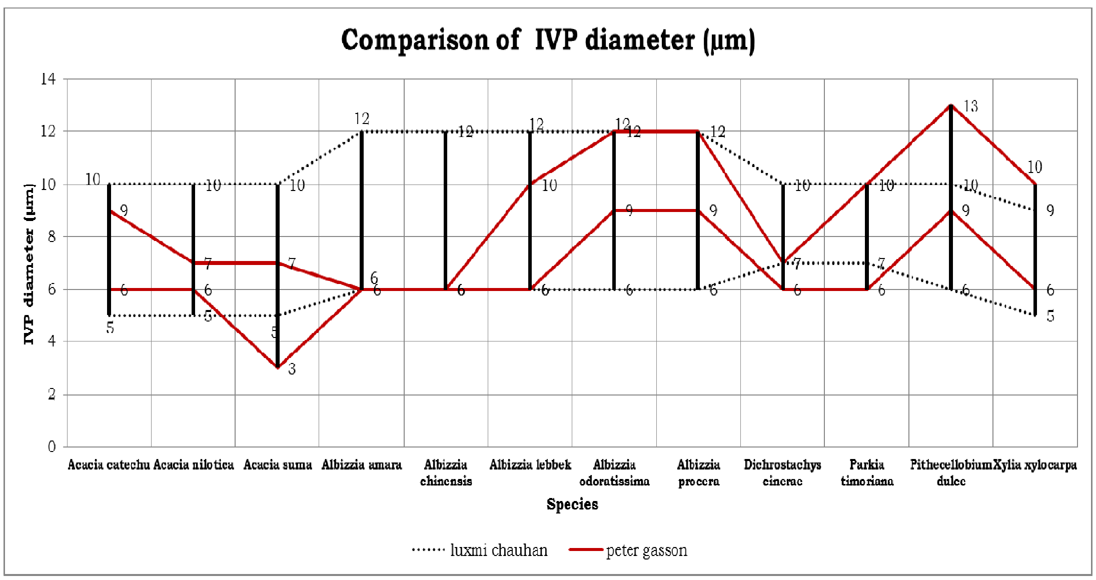

Figure-4
Comparative ranges of IVP diameter

Conclusion

This survey has shown the possibilities and limits for identification of mimosid woods. The geographical limitation was a prerequisite for this study and it has to be kept in mind that additional taxa may belong to the recognized types. Though it is known that no variations are found in the anatomical features of the species wherever it is grown, but from the study it is observed that with the geographical variations some characteristics are affected. From the study it is found that:

Acacia catechu, Albizia amara, Albizia lebbek, Albizia odoratissima, Albizia procera, Dichrostachys cinerae, and Xylia xylocarpa. The study reflects that growth ring character is affected by the change of geographical location.

The number of vessels/ sq. mm. for the following species Acacia nilotica, Xylia xylocarpa and Acacia suma is affected by the change in geography of the location. Geographical variation has a higher effect on the variation in Inter Vessel Pits diameter.

Numbers of cells/strand change with geography for Albizia odoratissima, i.e., from Uttar Pradesh, India to Indo-china region. The presence of homogenous ray cell remains unaffected from the change in the location of the trees.
The septate fibres character does not remain constant for Pithecellobium dulce as the location changes.

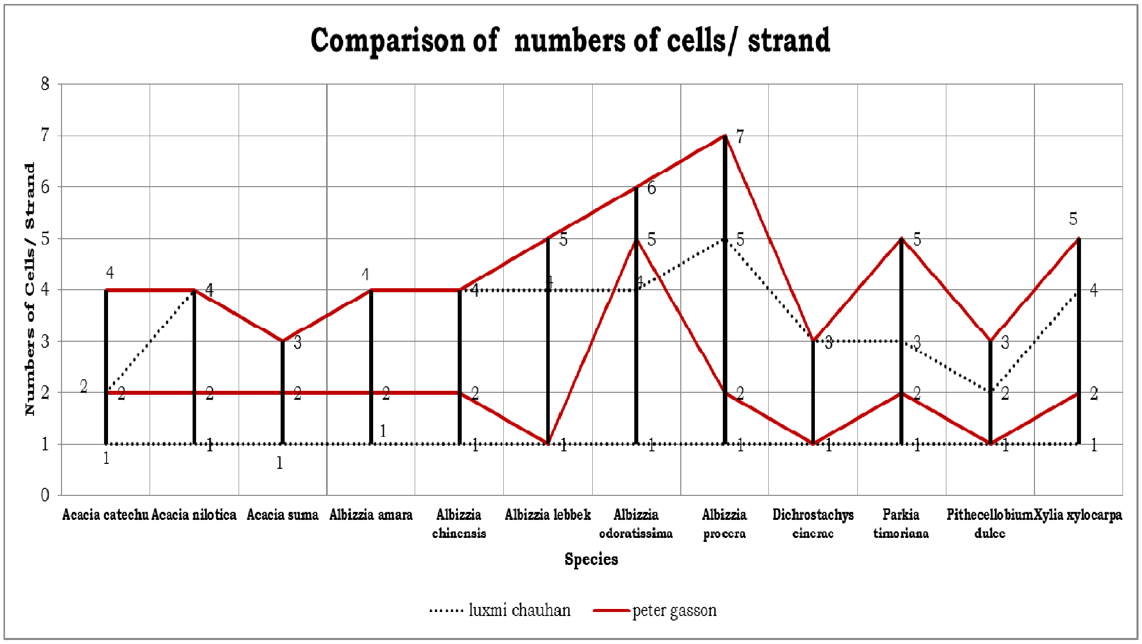

Figure-5
Comparative ranges of numbers of cells/strand

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