



# काष्ठ विज्ञान एवं प्रौद्योगिकी संस्थान

भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद्  
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार की एक स्वायत्त निकाय  
पी.ओ. मल्लेश्वरम बेंगलुरु - 560 003.



## INSTITUTE OF WOOD SCIENCE AND TECHNOLOGY

Indian Council of Forestry Research and Education  
An Autonomous Body of Ministry of Environment, Forest and Climate Change, Govt. of India  
P.O. Malleswaram, Bengaluru - 560 003.

No. 9-65/16-17/WPEW/IWST/mangrove-project/152/2337 22.10.2019

To,

The Executive Director,  
& Add. Principal Chief Conservator of Forests,  
Office of the Mangrove Foundation  
302, Wakefield House  
Ballard Estate, SS Ram Gullam Marg, Fort,  
Mumbai-400 001.  
Ph.: 022-22694984

Sub: Submission of progress report and Utilisation Certificate for the project 'Wood anatomical studies of important mangrove species from Maharashtra sea coast for the identification'.

Ref: Sanction Letter No.ADMIN/2016-2017/3555 dt. 20.03.2017  
This office letter No. 9-65/16-17/WPEW/IWST/mangrove-project/ 215/2882

Sir,

Please find enclosed here with the progress report, fund utilisation certificate, annexure for breakup of expenses of the above said project for the period April-September 2019.

Yours faithfully,

  
(Dr. M.P. Singh, IFS)  
Director

- Encl:** 1. U.C  
2. Annexure of break-up of expenses  
3. Progress report

o/c

22/10/19

# Fund Utilization Certificate

To,

The Executive Director,  
& Add. Principal Chief Conservator of Forests,  
Office of the Mangrove Foundation  
302, Wakefield House  
Ballard Estate, SS Ram Gullam Marg, Fort,  
Mumbai-400 001.  
Ph.: 022-22694984

Sub: Submission of Fund utilization certificate for the project: Wood anatomical studies of important mangrove species from Maharashtra Sea coast for the identification.

Ref: Sanction Letter No.ADMIN/2016-2017/3555 dt. 20.03.2017

Sir,

As per the terms of the sanction of the above project and release of funds, Please find herewith the "Fund Utilization Certificate" up to 10.10.2019 as under:

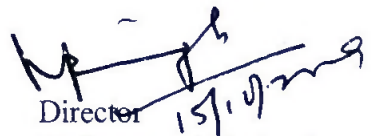
1. Funds received :Rs.24,35,000/-
2. Total expenditure incurred : Rs. 22,23,519 /-
3. Balance : Rs. 2,11,481/-

1. Certified that the conditions on which the grant in aid was sanctioned and received in favour of Director, Institute of Wood Science and Technology, Bengaluru, a sum of Rs. 22,23,519 /- (Rs. Twenty two lakh twenty three thousand five hundred nineteen only) has been utilized for the purpose for which it was sanctioned and that the balance of Rs. 2,11,481/- (Rs. Two lakh eleven thousand four hundred eighty one only) remaining unutilized at the end of 10.10.2019 will be adjusted towards the grants -in -aid payable during the next instalment.
2. Certified that I have satisfied myself that the conditions on which grants-n-aid was sanctioned have been duly fulfilled and I have exercised the checks to see money was actually utilised for the purpose for which it was sanctioned.

G.S.C. Rao  
11/10/19

Drawing and Disbursing officer

Institute of Wood Science and Technology  
Bengaluru.

  
Director  
15/10/2019

Institute of Wood Science and Technology  
Bengaluru.

## Annexure-A

Statement showing the expenditure as on 10.10.2019

<b>Heads</b>	<b>Amount approved (Rs.)</b>	<b>Amount released (Rs.)</b>	<b>Amount spent (Rs)</b>	<b>Balance amount (Rs)</b>
M&S	1,00,000	1,00,000	71,685	28,315
Travel	2,00,000	2,00,000	2,03,707	-3,707
Contingency	2,45,000	2,45,000	1,26,578	1,18,422
Project Asst.	2,52,000	2,52,000	3,37,533	-85,533
Equipment	12,00,000	12,00,000	11,52,016	47,984
Consultancy	1,20,000	1,20,000	14,000	1,06,000
Sub total	21,17,000	21,17,000	19,05,519	2,11,481
Institutional charges(15%)	3,18,000	3,18,000	3,18,000	-
<b>Total</b>	<b>24,35,000</b>	<b>24,35,000</b>	<b>22,23,519</b>	<b>2,11,481</b>



# काष्ठ विज्ञान एवं प्रौद्योगिकी संस्थान

भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद्  
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार की एक स्वायत्त निकाय  
पी.ओ. मल्लेश्वरम बेंगलुरु - 560 003.



## INSTITUTE OF WOOD SCIENCE AND TECHNOLOGY

Indian Council of Forestry Research and Education  
An Autonomous Body of Ministry of Environment, Forest and Climate Change, Govt. of India  
P.O. Malleswaram, Bengaluru - 560 003.

No. 9-65/16-17/WPEW/IWST/mangrove-project/

.10.2019

To,

The Executive Director,  
& Add. Principal Chief Conservator of Forests,  
Office of the Mangrove Foundation  
302, Wakefield House  
Ballard Estate, SS Ram Gullam Marg, Fort,  
Mumbai-400 001.  
Ph.: 022-22694984

Sub: Requesting to extend the project period without additional funds for the project:  
“Wood anatomical studies of important mangrove species from Maharashtra sea coast for the identification”.

Sir,

With reference to the subject above, Smt. S. Shashikala, ACTO, the Project Investigator, of the above mentioned project, attended the project review meeting held at Mumbai on 16<sup>th</sup> of September 2019 under your chairmanship. During the meeting it was discussed that the results of the project may be brought out as brochure/book after the completion of the project. PI has requested that to bring out the results in the form of a book, an extension of the project period up to March 2020 without additional funds is needed.

I, therefore request you to kindly extend the project period up to 31<sup>st</sup> March 2020 without additional funds so that a book on anatomy of important mangrove species of Maharashtra may be published. Approval for the same may kindly be communicated at the earliest.

Yours faithfully,

  
(Dr. M. P. Singh, IFS)  
Director

**Project**

**Wood anatomical studies of important mangrove species from Maharashtra sea coast for the identification.**

**Project Investigator**

**S. Shashikala**

**Duration of the project**

**April 2017- December 2019**

**Report Period**

**April 2019- September 2019.**

**Project Title: Wood anatomical studies of important Mangrove species from Maharashtra Sea coast for the identification.**

**Project Investigator: S. Shashikala**

**Duration of the project: April 2017- December 2019**

**Report Period: April 2019-September 2019.**

### **Summary of the project**

Data on Physical properties and microstructure of 12 mangrove species from Maharashtra will be collected. The macro (gross) and microstructure of wood material of a timber species is being used as fingerprint for its accurate and reliable identification. The collected data will be useful in identifying the mangrove species where illegal felling has taken place in Mangrove encroached areas of Maharashtra and will help in recovering the encroached areas.

### **Objectives**

1. To study microstructure and important physical properties of important mangrove species selected from two locations
2. To create database of anatomical properties of mangrove species from Maharashtra seacoast for their identification.

### **Progress for V half year (April 2019- September 2019).**

<b>Sl.No</b>	<b>Project activities (April - September 2019)</b>	<b>Progress of work</b>
1	M&S required for the work will be procured.	Chemical and glass wares were procured.
2	Preparation of wood samples for density, shrinkage.  Macerations of the samples (Two species : <i>Aegiceros corniculatum</i> , <i>Kandelia candel</i> )  Preparation of micro slides for collecting anatomical properties will be completed	Completed  Maceration of the samples of <i>A.corniculatum</i> and <i>K. candel</i> were prepared.  Preparation of microslides for 7 species:

	for 8 species ( <i>Aegiceras corniculatum</i> , <i>B.cylindrica</i> , <i>B.gymnorhiza</i> , <i>Kandelia candel</i> , <i>Heritiera littoralis</i> , <i>Lumnitzera racemosa</i> , <i>Rhizophora apiculata</i> , <i>S.caseolaris</i> )	<i>B.cylindrica</i> , <i>B.gymnorhiza</i> , <i>Heritiera littoralis</i> , <i>Kandelia candel</i> , <i>Lumnitzera racemosa</i> , <i>Rhizophora apiculata</i> , <i>S.caseolaris</i> (in triplicates) completed.
4	Moisture content, basic density and volumetric shrinkage will be studied for <i>Aegiceras corniculatum</i> , <i>Kandelia candel</i> .	Moisture content, density and shrinkage studies were completed and data analysed.
5	Fibre and vessel morphology will be studied for 2 species from macerated material (in triplicate) and Ray morphology, composition; vessel frequency will be studied from permanent microslides for 7 species.	Data on fibre and vessel morphology of <i>A.corniculatum</i> , <i>B.cylindrica</i> , <i>Heritiera littoralis</i> and <i>K. candel</i> were collected from macerated material. Ray morphology and vessel frequency studied for 7 species viz. <i>B.cylindrica</i> , <i>B.gymnorhiza</i> , <i>Heritiera littoralis</i> , <i>Kandelia candel</i> , <i>Lumnitzera racemosa</i> , <i>Rhizophora apiculata</i> , <i>S.caseolaris</i> (in triplicates).
6.	Description and codification of species	Photomicrography of the permanent slides is in progress.
7.	Submission of fifth - six monthly report	The report for the half year ending September 2019 will be submitted

**Objective 1:** To study microstructure and important physical properties of important mangrove species selected from two locations.

**Progress:** Moisture content, basic density and volumetric shrinkage have been studied for the following species. Almost all physical properties of timber vary with moisture content and it is therefore necessary that the moisture content of timber and its basic density/specific gravity be determined at the time of tests.

Specific gravity/ density and volumetric shrinkage have been determined for ten species during the reporting period. The results of specific gravity and volumetric shrinkage of all samples along with standard deviation are provided in Table 1.

**Table 1: Physical properties of all mangrove species**

Species	Sp.gr	SD	VS (%)	SD
<i>Aegiceras corniculatum</i> (T)	0.486	0.026	9.33	0.42
<i>Aegiceras corniculatum</i> (S)	0.645	0.014	9.52	1.03
<i>Avicennia marina</i> (T)	0.606	0.018	15.24	0.60
<i>Avicennia marina</i> (S)	0.836	0.098	14.18	1.09
<i>Avicennia officinalis</i> (T)	0.514	0.008	12.54	1.43
<i>Avicennia officinalis</i> (S)	0.706	0.009	10.90	0.23
<i>Bruguiera cylindrica</i>	0.658	0.013	10.28	0.48
<i>Bruguiera gymnorrhiza</i>	0.749	0.025	10.61	0.42
<i>Ceriops tagal</i>	0.755	0.016	11.91	0.50
<i>Cynometra iripa</i>	0.762	0.025	12.40	2.40
<i>Excoecaria agallocha</i>	0.351	0.023	8.62	1.61
<i>Heritiera littoralis</i>	0.614	0.009	9.18	0.92
<i>Kandelia candel</i>	0.517	0.018	12.10	2.66
<i>Rhizophora apiculata</i>	0.849	0.008	12.33	0.64
<i>Rhizophora mucronata</i>	0.799	0.041	14.27	2.08
<i>Sonneratia alba</i>	0.391	0.016	12.60	2.24
<i>Sonneratia apetala</i>	0.461	0.018	10.58	1.77
<i>Sonneratia caseolaris</i>	0.467	0.015	8.56	0.90
<i>Xylocarpus granatum</i>	0.679	0.014	8.11	0.84
<i>Lumnitzera racemosa</i>	0.667	0.028	-*	-*

(T) - Thane (S) – Sindhudurg

\* Due to the small size of the specimen of *Lumnitzera racemosa*, shrinkage test could not be performed.

*Rhizophora apiculata* (0.849) being the heaviest timber and *Excoecaria agallocha* (0.351) being the lightest timber among the 17 mangrove species studied. *Xylocarpus*



*granatum* (8.11%) showed the lowest shrinkage % and *Avicennia marina* (T) (15.24%) showed the highest shrinkage % among the 17 mangrove species studied. It is also noted that the samples of *A. marina* and *A. officinalis* collected from Sindudurg district showed a lesser percent of shrinkage compared to samples collected from Thane, whereas, density of the samples showed a reverse trend i.e. samples collected from Sindudurg showed higher density. The exact reason for this is in question.

Data on fibre and vessel morphology of *A. corniculatum*, *B. cylindrical*, *H. littoralis* and *K. candel* were collected from macerated material. Ray morphology and vessel frequency studied for 7 species.

**Objective 2:** To create database of anatomical properties of mangrove species from Maharashtra seacoast for their identification

**Progress:** Data on fibre morphology (fibre length, fibre diameter and fibre wall thickness), vessel morphology (vessel element length, vessel diameter and vessel frequency) have been collected from macerated material in order to know their variations in individual trees of *Aegiceras corniculatum*, *Bruguiera cylindrica*, *Heritiera littoralis*, *Kandelia candel*. The results of three individual samples are given in Table 2.

**Table 2: Fibre and Vessel morphology in four different mangrove species.**

Sl. No	Species	Sample	Vessel element length (µm)	Vessel diameter (µm)	Vessel frequency (/mm <sup>2</sup> )	Fibre length (µm)	Fibre diameter (µm)	Fibre wall thickness (µm)
1	<i>Aegiceras corniculatum</i>	1	214	43	276	375	24.93	9.66
		2	214	45	329	399	23.38	8.73
		3	208	43	282	411	24.22	9.25
2	<i>Bruguiera cylindrica</i>	1	772	83	31	1167	24.80	13.17
		2	687	82	28	1116	24.42	13.85
		3	701	84	30	1112	26.17	15.97
3	<i>Heritiera littoralis</i>	1	294	104	6	1535	18.85	9.71
		2	277	77	8	1599	18.69	10.37
		3	291	125	8	1622	18.51	9.66

4	<i>Kandelia candel</i>	1	521	71	41	1090	20.31	8.89
		2	594	77	32	1174	23.85	11.06
		3	632	71	51	1180	23.92	9.65

Ray morphology was studied using the permanent section (micro-slides). For studying the ray frequency, ray width and ray height, tangential longitudinal sections were used. Ray morphology was studied for 7 species during the reporting period. The results of average values of three samples obtained are shown in Table 3.

**Table 3: Ray morphology of seven mangrove species**

Sl. No.	Species	Frequency/ sq.mm	Seriation	Ray Width ( $\mu\text{m}$ )		Ray height ( $\mu\text{m}$ )	
				Uni	Multi	Uni	Multi
1	<i>Bruguiera cylindrica</i>	3-7	3-5	----	63-155	----	695- 2579
2	<i>Bruguiera gymnorhiza</i>	3-8	3-5	----	68-158	----	792- 2489
3	<i>Heritiera littoralis</i>	4-7	3-7	12-33	High rays 92-146	157-290	High rays 688- 1369
					Low rays 49-102		Low rays 223-641
4	<i>Lumnitzera racemosa</i>	9-16	1-2	18-39	----	155-585	----
5	<i>Kandelia candel</i>	4-9	3-5	12-25	40-145	127-467	736- 2190
6	<i>Rhizophora apiculata</i>	3-9	3-5	----	64-131	----	552- 2681
7	<i>Sonneratia caseolaris</i>	9-17	1	11-27	----	96-519	----

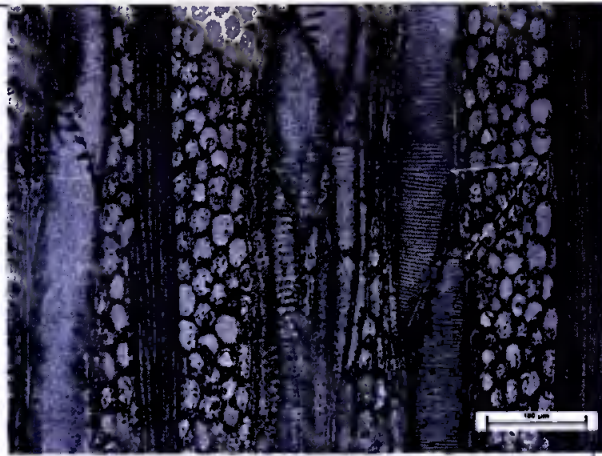
The above anatomical properties studied will be used in describing the anatomy of the species and further will be utilised in codification of the data base as per IAWA (1989).

**Plan of Work for October 2019- December 2019 for the project titled “Wood anatomical studies of Important mangrove species from Maharashtra Sea Coast for the identification”.**

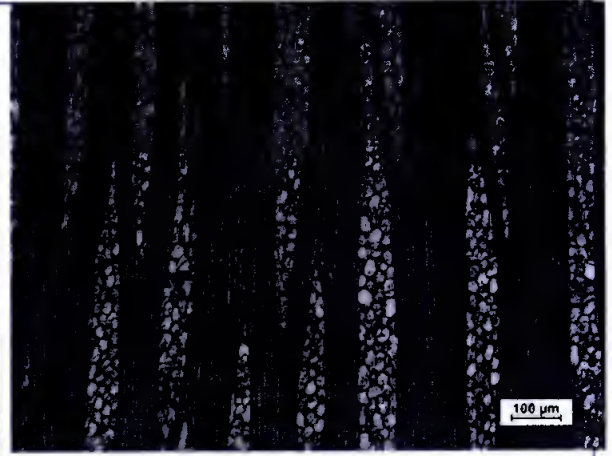
**PI: S.Shashikala, Asst. Chief Technical Officer, IWST.**

Sl.No	List of project activities	Plan of work (October- December 2019)
1	Purchase of chemicals and glass wares, M&S.	M&S required for the work will be procured.
2	Preparation of samples	Maceration of 2 species ( <i>Cynometra iripa</i> , <i>Xylocarpus granatum</i> ) will be carried out. Preparation of micro slides for collecting anatomical properties will be completed for remaining three species ( <i>Aegiceros corniculatum</i> , <i>Cynometra iripa</i> , <i>Xylocarpus granatum</i> )
4	Study of anatomical properties	Anatomical data collected from macerated material will be arranged for analysis. Ray morphology, composition; vessel frequency will be studied from permanent microslides for three species.
6.	Description and codification of species	Photomicrography of the permanent slides.  Description of the species will be done based on gross structure and minute anatomy. Codification as per IAWA 1989.
7.	Submission of sixth - report	The report for the year ending December 2019 will be submitted*

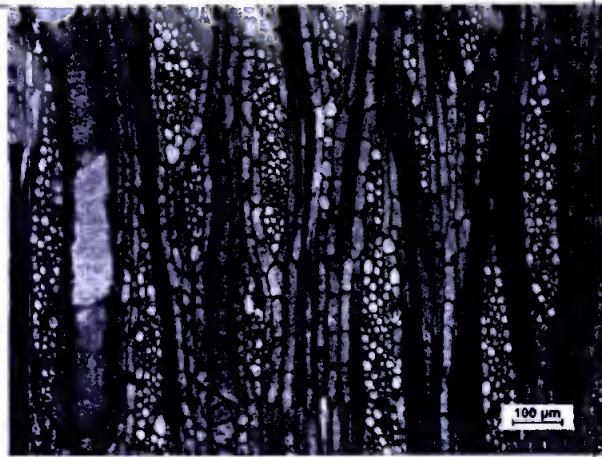
\*As per the discussions held on 16.09.2019 with Executive Director, Mangrove cell, Mumbai , a phase II project proposal for inclusion of mangrove associates will be proposed. Documentation of the wood anatomy of mangrove species studied in the present project will be published as a brochure/book. Hence a request for extension of the project period upto March 2020 is sought to complete the documentation work and will be published during the extended period.



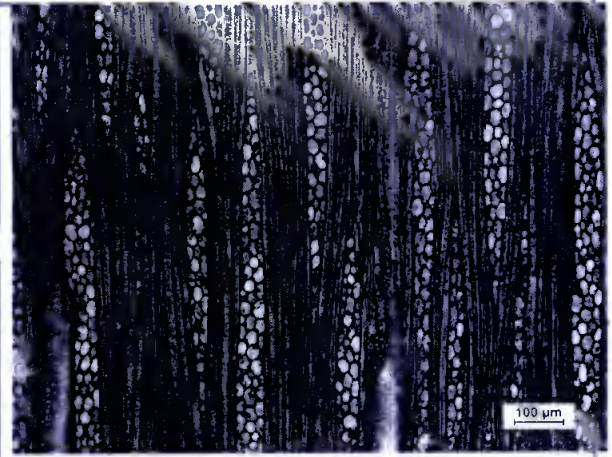
*Bruguiera cylindrica* T.L.S



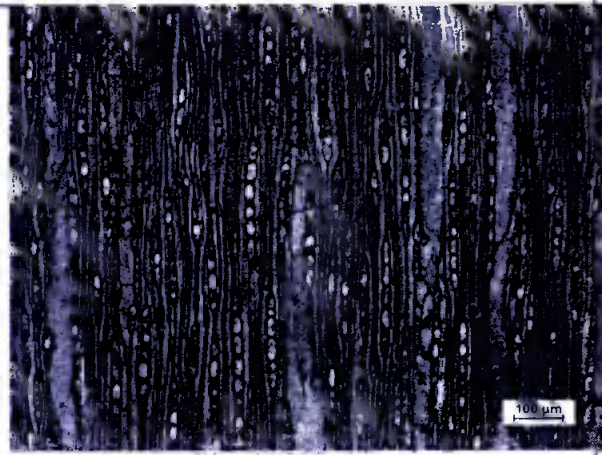
*Bruguiera gymnorrhiza* T.L.S



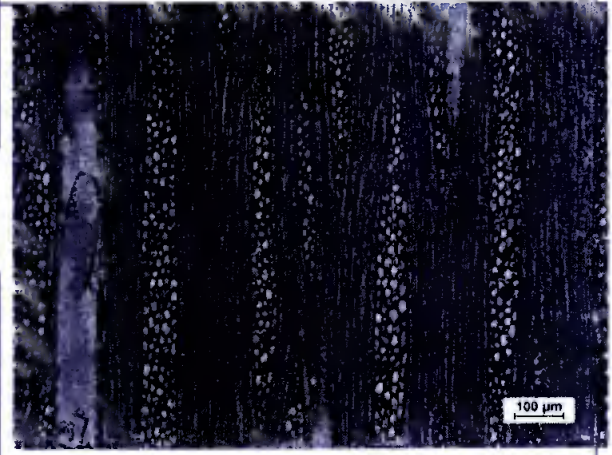
*Heritiera littoralis* T.L.S



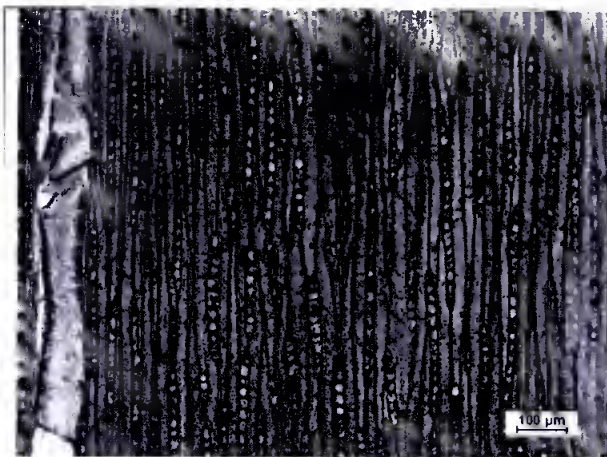
*Kendalia candel* T.L.S



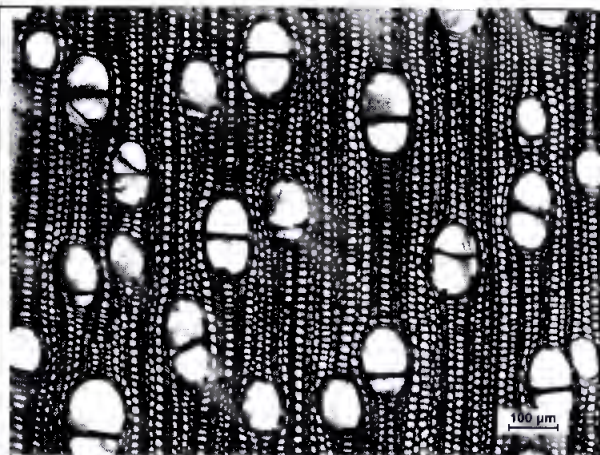
*Lumnitzera racemosa* T.L.S



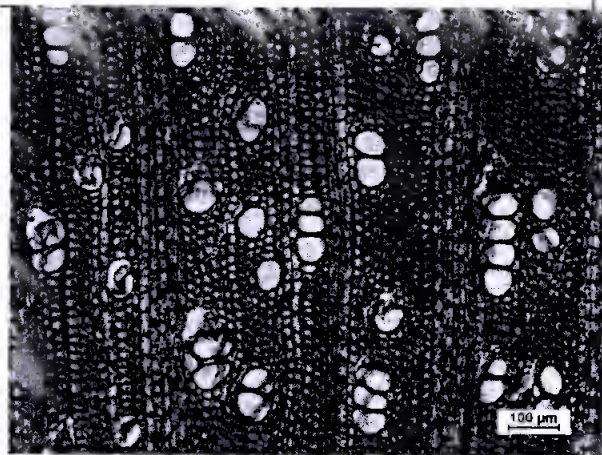
*Rhizophora apiculata* T.L.S



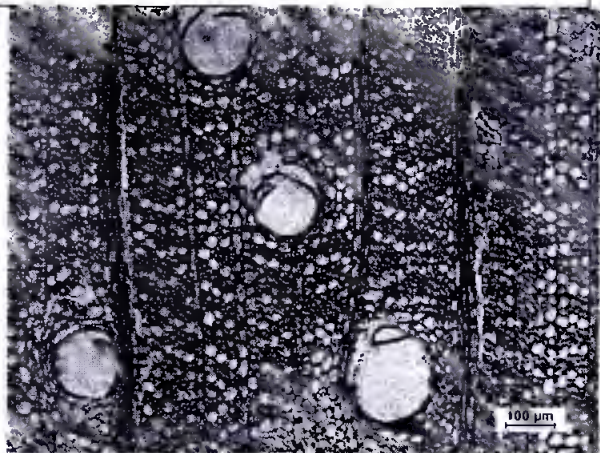
*Sonneratia caseolaris* T.L.S



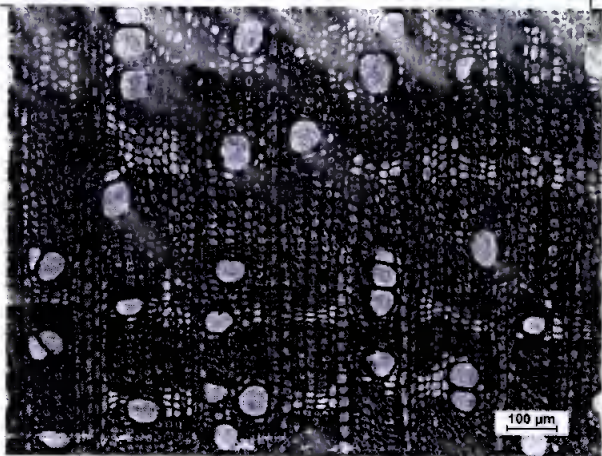
*Sonneratia caseolaris* C.S



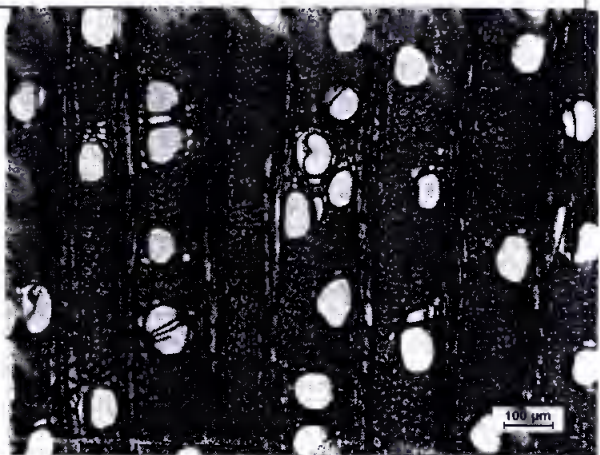
*Bruguiera cylindrica* C.S



*Heritiera littoralis* C.S



*Kendalia candel* C.S



*Rhizophora apiculata* C.S