



**UNIVERSITI PUTRA MALAYSIA**

**TAXONOMIC STUDIES OF THE GENUS *DURIO* (BOMBACACEAE)  
AND CLONAL VARIATION IN *D. ZIBETHINUS***

**SALMA BINTI IDRIS**

**FSAS 1996 20**

**TAXONOMIC STUDIES OF THE GENUS *DURIO* (BOMBACACEAE)  
AND CLONAL VARIATION IN *D. ZIBETHINUS***

**By**

**SALMA BINTI IDRIS**

**Dissertation Submitted in Fulfilment of the Requirement for  
the Degree of Doctor of Philosophy in the Faculty of  
Science and Environmental Studies,  
Universiti Pertanian Malaysia.**

**1996**



## ACKNOWLEDGEMENTS

I would like to express my sincere thanks and special gratitude to the Chairman Prof. Ruth Kiew for her guidance, advice, constructive criticisms and patience throughout the course of the present study. My appreciation is also extended to members of Supervisory Committee Dr. E. Soepadmo, Dr. Umi Kalsom bt. Yusof and Prof Tan Soon Guan for their guidance, comments and suggestions during the preparation of the thesis.

This research was financially supported by the Malaysian Agricultural Research and Development Institute (MARDI) to whom I am deeply indebted. I would like to express my gratitude to the Director General, the Deputy Director General of MARDI and the former Director of Basic Research Division, Dr. Ahmad Zam Zam Mohamad for their permission to undertake the present study.

I am extremely grateful to the curators from the following herbaria for the loan of specimens: KEP, SAN, SAR and SING. I also wish to thank Dr. Zainal Abidin Mohamad for the use of his durian germplasm materials and I would like also to thank the head of the Department of Agriculture, Serdang for the permission to use their durian clones.

I wish to thank Dr. Fauziah Othman, Mr. Ho and Mrs. Aminah from University of Agriculture for their assistance in scanning electron microscopy (SEM).



I wish to express my thanks also to Mr. Masrom Hasran, Mr. Tuan Othman Tuan Abdullah, Mr. Shohimie Ramli, Mr. Yahya Ishak and Mrs. Faridah Idris for their technical assistance. I also would like to express my deep appreciation to Mrs. Zaharah Talib for her assistance in statistical and numerical analysis.

I also would like to thank Dr. Zainal Abidin Mohamad, Mr. Said Gaduk, Ms. Mary Tan and Mr. Abdul Jamil Zakaria for the use of some of their photographs.

It is also a pleasure to record my gratitude to Dr. Mohd Yusoff Abdullah, Mrs. Wan Faridah Wan Jaafar and Mrs. Maznah Ismail for their help and also to my friends who have helped me in one way or another.

Lastly, I am especially indebted to my husband and my children for their encouragement, understanding and patience throughout my study.



# TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS . . . . .	iii
LIST OF TABLES . . . . .	x
LIST OF FIGURES . . . . .	xii
LIST OF PLATES . . . . .	xiv
ABSTRACT . . . . .	xxviii
ABSTRAK . . . . .	xxxii
CHAPTER	
1 GENERAL INTRODUCTION . . . . .	1
Industrial Status of Durian in Malaysia . . . . .	4
Phenology . . . . .	7
Objectives of the Study . . . . .	10
2 LITERATURE REVIEW . . . . .	11
Historical Review . . . . .	11
Ecology and Distribution . . . . .	12
Morphological Evidence . . . . .	13
Anatomical Evidence . . . . .	15
Palynological Evidence . . . . .	16
Development of Durian Clones . . . . .	17
Characterisation . . . . .	18
3 VEGETATIVE MORPHOLOGY OF <i>DURIO</i> SPECIES . . . . .	19
Habit, Crown, Stem and Branches . . . . .	19
Introduction . . . . .	19
Materials and Method . . . . .	20
Results . . . . .	21
Discussion and Conclusions . . . . .	27



	Leaf Macromorphology . . . . .	29
	Introduction . . . . .	29
	Materials and Methods . . . . .	30
	Results . . . . .	30
	Discussion and Conclusions . . . . .	40
	Leaf Micromorphology . . . . .	44
	Introduction . . . . .	44
	Materials and Methods . . . . .	45
	Results . . . . .	46
	Discussion and Conclusions . . . . .	56
4	COMPARATIVE ANATOMY OF LAMINA . . . . .	63
	Introduction . . . . .	63
	Materials and Methods . . . . .	64
	Results and Discussion . . . . .	65
	Conclusions . . . . .	82
5	FLORAL MACROMORPHOLOGY OF <i>DURIO</i> SPECIES . . . . .	83
	Introduction . . . . .	83
	Materials and Methods . . . . .	84
	Results and Discussion . . . . .	84
	Conclusions . . . . .	97
6	PALYNOLOGY . . . . .	102
	Introduction . . . . .	102
	Materials and Methods . . . . .	103
	Results and Discussion . . . . .	104
	Conclusions . . . . .	109
7	FRUIT MORPHOLOGY AND SEED MORPHOLOGY OF <i>DURIO</i> SPECIES . . . . .	112
	Introduction . . . . .	112
	Materials and Methods . . . . .	113
	Results . . . . .	113
	Discussion and Conclusions . . . . .	123



8	GENERAL DISCUSSION AND CONCLUSIONS . . . . .	129
9	GENERIC AND SPECIES TREATMENT . . . . .	138
	Description of the Genus <i>Durio</i> . . . . .	138
	Key To The <i>Durio</i> Species . . . . .	141
	Description of The <i>Durio</i> Species . . . . .	144
10	VEGETATIVE MORPHOLOGY OF DURIAN CLONES . . . . .	231
	General Introduction . . . . .	231
	Habit, Crown, Stem and Branches . . . . .	232
	Materials and Methods . . . . .	232
	Results and Discussion . . . . .	233
	Conclusions . . . . .	243
	Leaf Macromorphology . . . . .	243
	Introduction . . . . .	243
	Materials and Methods . . . . .	244
	Results . . . . .	244
	Discussion and Conclusions . . . . .	253
	Leaf Micromorphology . . . . .	254
	Introduction . . . . .	254
	Materials and Methods . . . . .	255
	Results . . . . .	255
	Discussion and Conclusions . . . . .	257
11	LEAF ANATOMY OF <i>DURIO ZIBETHINUS</i> . . . . .	259
	Introduction . . . . .	259
	Materials and Methods . . . . .	259
	Results . . . . .	260
	Discussion and Conclusions . . . . .	268



12	FLORAL MORPHOLOGY OF CLONES OF <i>DURIO ZIBETHINUS</i> . . . . .	270
	Introduction . . . . .	270
	Materials and Methods . . . . .	271
	Results . . . . .	271
	Discussion and Conclusions . . . . .	282
13	FRUIT AND SEED MORPHOLOGY OF DURIAN CLONES	290
	Introduction . . . . .	290
	Materials and Methods . . . . .	291
	Results . . . . .	291
	Discussion and Conclusions . . . . .	304
14	NUMERICAL TAXONOMY OF DURIAN CLONES . . . . .	310
	Introduction . . . . .	310
	Materials and Methods . . . . .	311
	Results and Discussion . . . . .	317
	Conclusions . . . . .	331
15	DISCUSSION AND CONCLUSIONS . . . . .	334
16	CONCLUSIONS AND SUMMARY . . . . .	338
	REFERENCES . . . . .	342
	APPENDICES . . . . .	352
	A : All Plates . . . . .	352
	B : List of Herbarium Specimens . . . . .	386
	C : List of <i>Durio</i> Tree Species . . . . .	392
	D : Vegetative Characters of <i>Durio</i> Species . . . . .	393
	E : Leaf Characters of <i>Durio</i> Species . . . . .	395
	F : Specimens for Anatomical Studies . . . . .	339
	G : Anatomical Characters of <i>Durio</i> Species . . . . .	401
	H : Floral Characters of <i>Durio</i> Species . . . . .	404
	I : Exomorphological Characters of Pollen in <i>Durio</i> Species . . . . .	415
	J : Fruit Characters of <i>Durio</i> Species . . . . .	417
	K : List of Durian Clones . . . . .	422





L :	Tree Habit of Durian Clones . . . . .	425
M :	Leaf Characters of Durian Clones . . . . .	427
N :	Floral Characters of Durian Clones . . . . .	431
O :	Fruit Characters of Durian Clones . . . . .	443
BIBLIOGRAPHICAL SKETCH . . . . .		467



## LIST OF TABLES

Table		Page
1	Distribution of <i>Durio</i> Species in Malaysia . . . . .	2
2	Hectarage of Cultivated Durian in Malaysia in the Year 1990 and 1992 . . . . .	5
3	Vegetative Characters of <i>Durio</i> Species . . . . .	22
4	Leaf Characters of <i>Durio</i> Species . . . . .	31
5	<i>Durio</i> Species Grouped According to Scale Density . . . . .	42
6	Micromorphological Characters of <i>Durio</i> Leaf . . . . .	47
7	Epidermal Cell Characters of the <i>Durio</i> Species . . . . .	66
8	Anatomical Characters of Lamina of <i>Durio</i> Species . . . . .	71
9	Combination of Leaf Anatomical Characters for Identification of Sterile Specimens of <i>Durio</i> Species . . . . .	81
10	Floral Characters of <i>Durio</i> Species . . . . .	85
11	Some <i>Durio</i> Species with Special Flower Characteristics . . . . .	101
12	Exomorphological Pollen Characters of <i>Durio</i> Species . . . . .	106
13	Diagnostic Pollen Characters of Some <i>Durio</i> Species . . . . .	110
14	Fruit Characters of <i>Durio</i> Species . . . . .	113
15	Characters that Distinguish <i>Durio affinis</i> from <i>D. testudinarum</i> . . . . .	147
16	Characters of Tree Habit of Durian Clones . . . . .	234
17	Leaf Characters of Durian Clones . . . . .	246
18	Anatomical Characters of <i>Durio zibethinus</i> Leaf . . . . .	263



19	Epidermal Cell Characters of Durian Clones . . . . .	265
20	Flower Characters of Durian Clones . . . . .	273
21	Correlation of Some Flower Characters of Durian Clones . . . . .	287
22	Fruit Characters of Durian clones . . . . .	292
23	Differences in Fruit Characters of Some Closely Related Durian Clones . . . . .	308
24	Morphological Characters of Durian Clones and Their Character States . . . . .	313
25	Description of the Major Groups of Durian Clones . . . . .	332
26	Varimax Solution for 12 Characters that Show Their Highest Loadings on the First 3 Components . . . . .	333
27	<i>Durio</i> Species in Malaysia . . . . .	341



## LIST OF FIGURES

Figure		Page
1	A Map Showing Concentrations of Durian Cultivating Areas (A-P) and Commercial Durian Estates . . . . .	6
2	Distribution of <i>Durio</i> Species . . . . .	14
3	Leaf Shapes of <i>Durio</i> Species . . . . .	36
4	Types of Trichomes . . . . .	50
5	Leaf Architectural Features Showing the Orders of Venation and Configuration in <i>Durio</i> Leaf . . . . .	54
6	Transverse Section of Midrib of <i>Durio</i> Leaves . . . . .	78
7	Petal Shape in <i>Durio</i> Species . . . . .	91
8	Types of Calyx Shape in <i>Durio</i> Species . . . . .	91
9	Leaves of <i>Durio zibethinus</i> . . . . .	252
10	Transverse Section of <i>D. zibethinus</i> Leaf . . . . .	262
11	Variation in the Bud Shape of <i>D. zibethinus</i> . . . . .	278
12	Variation in the Calyx Tooth Shape of <i>D. zibethinu</i> 278	
13	Petal Shape of <i>D. zibethinus</i> . . . . .	278
14	Types of Style of <i>D. zibethinus</i> . . . . .	280
15	Stigma Shapes of <i>D. zibethinus</i> . . . . .	280
16	Shapes of Spines of <i>D. zibethinus</i> Fruit . . . . .	280
17	Distance Phenogram Produced by Single Linkage . . . . .	318
18	Distance Phenogram Produced by Complete Linkage . . . . .	319
19	Distance Phenogram Produced by Average Linkage . . . . .	320
20	Distance Phenogram Produced by WARD's Method . . . . .	321



21	Dendrogram based on alkaline phosphatase . . . . .	324
22	Dendrogram based on peroxidase . . . . .	325
23	Varimax Solution for Component 1 and 2 . . . . .	326
24	Example of Morphological Vector Obtained From Correlation Coefficient Matrix That can be Used to Characterise Certain Groups of OTUs Found in Fig. 21 . . . . .	327
25	Varimax Solution for Component 1 and 3 . . . . .	328
26	Example of Morphological Vector Obtained From Correlation Coefficient Matrix That can be Used to Characterise Certain Groups of OTUs Found in Fig. 23 . . . . .	329
25	Dendrogram of peroxidase isozyme . . . . .	
26	Dendrogram of alkaline phosphatase isozyme . . . . .	



## LIST OF PLATES

Plate		Page
1	SEM of Abaxial Leaf Surface of <i>D. affinis</i> . . . . .	352
2	LM of Trichome on Abaxial Leaf Surface of <i>D. affinis</i> . . . . .	352
3	SEM of Abaxial Leaf Surface of <i>D. carinatus</i> . . . . .	352
4	LM of Trichome on Abaxial Leaf Surface of <i>D. carinatus</i> . . . . .	352
5	SEM of Adaxial Leaf Surface of <i>D. carinatus</i> . . . . .	352
6	SEM of Adaxial Leaf Surface of <i>D. grandiflorus</i> Showing the Wax Rods . . . . .	352
7	SEM of Abaxial Leaf Surface of <i>D. grandiflorus</i> . . . . .	352
8	LM of Trichome on Abaxial Leaf Surface of <i>D. grandiflorus</i>	352
9	SEM of Abaxial Leaf Surface of <i>D. griffithii</i> . . . . .	353
10	SEM of Adaxial Leaf Surface of <i>D. griffithii</i> . . . . .	353
11	SEM of Abaxial Leaf Surface of <i>D. griffithii</i> Showing Stellate Hair . . . . .	353
12	LM of Trichome on Abaxial Leaf Surface of <i>D. lanceolatus</i>	353
13	SEM of Abaxial Leaf Surface of <i>D. griffithii</i> var. <i>acutifolius</i> . . . . .	353
14	LM of Trichome on Abaxial Leaf Surface of <i>D. griffithii</i> var. <i>acutifolius</i> . . . . .	353
15	SEM of Abaxial Leaf Surface of <i>D. kutejensis</i> . . . . .	353
16	LM of Trichome on Abaxial Leaf Surface of <i>D. kutejensis</i> . . . . .	353
17	SEM of Abaxial Leaf Surface of <i>D. graveolens</i> . . . . .	354
18	SEM of Adaxial Leaf Surface of <i>D. graveolens</i> . . . . .	354
19	SEM of Adaxial Leaf Surface of <i>D. graveolens</i> Showing Stellate Hairs . . . . .	354



20	SEM of Adaxial Leaf Surface of <i>D. graveolens</i> Showing the Rod Wax . . . . .	354
21	SEM of Adaxial Leaf Surface of <i>D. graveolens</i> Showing the Stellate Hairs . . . . .	354
22	LM of Trichome on Abaxial Leaf Surface of <i>D. graveolens</i> . . . . .	354
23	SEM of Abaxial Leaf Surface of <i>D. dulcis</i> . . . . .	354
24	LM of Trichome on Abaxial Leaf Surface of <i>D. dulcis</i> . . . . .	354
25	SEM of Abaxial Leaf Surface of <i>D. singaporensis</i> . . . . .	355
26	LM of Trichome on Abaxial Leaf Surface of <i>D. singaporensis</i> . . . . .	355
27	SEM of Adaxial Leaf Surface of <i>D. singaporensis</i> Showing Stellate Hairs . . . . .	355
28	SEM of Abaxial Leaf Surface of <i>D. oxleyanus</i> . . . . .	355
29	SEM of Abaxial Leaf Surface of <i>D. testudinarum</i> . . . . .	355
30	LM of Trichome on Abaxial Leaf Surface of <i>D. testudinarum</i> . . . . .	351
31	LM of Trichome on Adaxial Leaf Surface of <i>D. excelsus</i> . . . . .	355
32	LM of Trichome on Adaxial Leaf Surface of <i>D. wyatt-smithii</i> . . . . .	355
33	SEM of Abaxial Leaf Surface of <i>D. lowianus</i> . . . . .	356
34	SEM of Adaxial Leaf Surface of <i>D. lowianus</i> Showing the Rod Wax . . . . .	356
35	LM of Trichome on Adaxial Leaf Surface of <i>D. lowianus</i> . . . . .	356
36	SEM of Abaxial Leaf Surface of <i>D. malaccensis</i> . . . . .	356
38	SEM of Adaxial Leaf Surface of <i>D. malaccensis</i> . . . . .	356
39	SEM of Abaxial Leaf Surface of <i>D. pinangianus</i> . . . . .	356
40	LM of Trichome on Adaxial Leaf Surface of <i>D. pinangianus</i> . . . . .	356
41	LM of Trichome on Adaxial Leaf Surface of <i>D. oblongus</i> . . . . .	356



42	SEM of Abaxial Leaf Surface of <i>D. macrophyllus</i> . . . . .	356
43	Glandular Trichome, One- to Two-Celled Stalk With Hemispherical Glandular Head . . . . .	357
44	Glandular Trichome, One- to Two-Celled Stalk With Multicellular Glandular Head . . . . .	357
45 & 46	Glandular Trichome, One- or Two-Celled Stalk With Ovoid Multicellular Glandular Head . . . . .	357
46	Trichome Base (TB) . . . . .	357
47	Glandular Trichome With Uniseriate Stalk and Hemispherical Head . . . . .	357
48	Acicular Trichome . . . . .	357
49	Stomata Arranged in a Complete Circle . . . . .	357
50	Stomata Arranged in a Partial Circle . . . . .	357
51	Leaf Venation in <i>D. acutifolius</i> . . . . .	358
52	Leaf venation in <i>D. lanceolatus</i> . . . . .	358
53	Leaf Venation in <i>D. pinangianus</i> . . . . .	358
54	Leaf Venation in <i>D. graveolens</i> . . . . .	358
55	Leaf Venation in <i>D. wyatt-smithii</i> . . . . .	358
56	Leaf Venation in <i>D. malaccensis</i> . . . . .	358
57	Leaf Venation in <i>D. singaporensis</i> . . . . .	358
58	Leaf Venation in <i>D. oxleyanus</i> . . . . .	358
59	Leaf Venation in <i>D. carinatus</i> . . . . .	358
60	Leaf Venation in <i>D. griffithii</i> . . . . .	358
61	Leaf Venation in <i>D. lowianus</i> . . . . .	358
62	Leaf Venation in <i>D. macrolepis</i> . . . . .	358
63	Leaf Venation in <i>D. excelsus</i> . . . . .	354





64	Leaf Venation in <i>D. dulcis</i> . . . . .	358
65	Leaf Venation in <i>D. affinis</i> . . . . .	358
66	Leaf Venation in <i>D. macrophyllus</i> . . . . .	358
67	Light Micrograph of Leaf Epidermis on Adaxial Surface Showing Anticlinal Wall in <i>D. lowianus</i> . . . . .	359
68	Light Micrograph of Leaf Epidermis on Adaxial Surface Showing Anticlinal Wall in <i>D. griffithii</i> . . . . .	359
69	Light Micrograph of Leaf Epidermis on Adaxial Surface Showing Anticlinal Wall in <i>D. excelsus</i> . . . . .	359
70	Light Micrograph of Leaf Epidermis on Adaxial Surface Showing Anticlinal Wall in <i>D. carinatus</i> . . . . .	359
71	Light Micrograph of Leaf Epidermis on Adaxial Surface Showing Anticlinal Wall in <i>D. malaccensis</i> . . . . .	359
72	Light Micrograph of Leaf Epidermis on Adaxial Surface Showing Anticlinal Wall in <i>D. testudinarum</i> . . . . .	359
73	Light Micrograph of Leaf Epidermis on Adaxial Surface Showing Anticlinal Wall in <i>D. zibethinus</i> . . . . .	359
74	Light Micrograph of Leaf Epidermis on Adaxial Surface Showing Anticlinal Wall in <i>D. wyatt-smithii</i> . . . . .	359
75	Light Micrograph of Leaf Epidermis on Adaxial Surface Showing Anticlinal Wall in <i>D. lanceolatus</i> . . . . .	359
76	Light Micrograph of Leaf Epidermis on Adaxial Surface Showing Anticlinal Wall in <i>D. graveolens</i> . . . . .	359
77	Light Micrograph of Leaf Epidermis on Adaxial Surface Showing Anticlinal Wall in <i>D. kutejensis</i> . . . . .	359
78	Light Micrograph of Leaf Epidermis on Adaxial Surface Showing Anticlinal Wall in <i>D. dulcis</i> . . . . .	359
79	Light Micrograph of Leaf Epidermis on Adaxial Surface Showing Anticlinal Wall in <i>D. pinangianus</i> . . . . .	359
80	Light Micrograph of Leaf Epidermis on Adaxial Surface Showing Anticlinal Wall in <i>D. crassipes</i> . . . . .	359



81	Light Micrograph of Leaf Epidermis on Adaxial Surface Showing Anticlinal Wall in <i>D. singaporensis</i> . . . . .	359
82	Light Micrograph of Leaf Epidermis on Adaxial Surface Showing Anticlinal Wall in <i>D. macrophyllus</i> . . . . .	359
83	Light Micrograph of Leaf Epidermis on Adaxial Surface Showing Anticlinal Wall in <i>D. oblongus</i> . . . . .	359
84 & 96	Transverse Section of Lamina of <i>D. carinatus</i> . . . . .	360 & 361
85	Transverse Section of Lamina of <i>D. affinis</i> . . . . .	360
86 & 93	Transverse Section of Lamina of <i>D. lanceolatus</i> . . . . .	360
87	Transverse Section of Lamina of <i>D. excelsus</i> . . . . .	360
88	Transverse Section of Lamina of <i>D. grandiflorus</i> . . . . .	360
89	Transverse Section of Lamina of <i>D. johoricus</i> . . . . .	360
90	Transverse Section of Lamina of <i>D. testudinarum</i> . . . . .	360
91	Transverse Section of Lamina of <i>D. kutejensis</i> . . . . .	360
92	Transverse Section of Lamina of <i>D. malaccensis</i> . . . . .	360
94	Transverse Section of Lamina of <i>D. cf. lanceolatus</i> . . . . .	360
95	Transverse Section of Lamina of <i>D. graveolens</i> . . . . .	360
97	Transverse Section of Lamina of <i>D. griffithii</i> . . . . .	361
98	Transverse Section of Lamina of <i>D. kinabaluensis</i> . . . . .	361
99	Transverse Section of Lamina of <i>D. pinangianus</i> . . . . .	361
100	Transverse section of lamina of <i>D. lowianus</i> . . . . .	361
101	Transverse Section of Lamina of <i>D. macrophyllus</i> . . . . .	361
102	Transverse Section of Lamina of <i>D. oxleyanus</i> . . . . .	361
103	Transverse Section of Lamina of <i>D. dulcis</i> . . . . .	361
104	Transverse Section of Lamina of <i>D. singaporensis</i> . . . . .	361



105	Transverse Section of Lamina of <i>D. singaporensis</i> var. <i>jerangauensis</i> . . . . .	361
106	Transverse Section of Lamina of <i>D. wyatt-smithii</i> . . . . .	361
107	Transverse Section of Lamina of <i>D. oblongus</i> . . . . .	361
108	<i>D. griffithii</i> Flower . . . . .	362
109	<i>D. oxleyanus</i> Flower . . . . .	362
110	<i>D. graveolens</i> Flower . . . . .	362
111 & 112	<i>D. lowianus</i> Flower . . . . .	362
113 & 114	<i>D. kutejensis</i> Flower . . . . .	362
115	<i>D. zibethinus</i> Flower . . . . .	362
116	<i>D. malaccensis</i> Flower . . . . .	362
117	<i>D. singaporensis</i> Flower . . . . .	362
118	<i>D. singaporensis</i> var. <i>jerangauensis</i> Flower . . . . .	363
119	<i>D. griffithii</i> Showing Solitary Flowers at Fallen Leaf Axils on Branches . . . . .	363
120	<i>D. lowianus</i> Showing Ramiflorous Cymose Inflorescence . . .	363
121	<i>D. carinatus</i> Showing Ramiflorous Cymose Inflorescence . . .	364
122	<i>D. singaporensis</i> Showing a Short Branched Inflorescence on a Branch . . . . .	364
123	<i>D. malaccensis</i> Showing the Inflorescence on the Trunk . . .	364
124	<i>D. malaccensis</i> Showing a Single Flower or a Short Branched Inflorescence on Bosses . . . . .	364
125	<i>D. testudinarum</i> Showing Inflorescences at the Base of the Trunk . . . . .	365
126	<i>D. zibethinus</i> Showing a Close up of the Cymose Inflorescence on a Branch . . . . .	365
127	<i>D. graveolens</i> Showing a Terminal Flower . . . . .	365



128	<i>D. graveolens</i> Showing a Terminal Bud . . . . .	365
129	Stamens Free ( <i>D. griffithii</i> ) . . . . .	365
130	Stamens in Phallanges ( <i>D. lowianus</i> ) . . . . .	365
131	Stamens Forming a Staminal Tube <i>D. singaporensis</i> . . . . .	365
132	Round Anther With Apical Pore ( <i>D. griffithii</i> ) . . . . .	365
133	Disc-Shaped Anther Dehiscing Circularly ( <i>D. oxleyanus</i> ) . . .	365
134	Reniform Anther Dehiscing in a Longitudinal Slit ( <i>D. lowianus</i> ) . . . . .	365
135	Reniform Anthers of <i>D. graveolens</i> Showing the Hairs Along the Edge . . . . .	365
136	Scales on the Outer Surface of Epicalyx . . . . .	366
137	Stellate Hairs on the Inner Surface of Epicalyx . . . . .	366
138	Stellate Hairs on the Inner Surface of Calyx . . . . .	366
139	Acicular Hairs on the Inner Surface of Calyx . . . . .	366
140	Long Fimbriated Trichome on the Outer Surface of Petal . .	366
141	Stellate Hairs on a Style . . . . .	366
142	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. pinangianus</i> . . . . .	367
143	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. affinis</i> . . . . .	367
144	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. lowianus</i> . . . . .	367
145	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. kutejensis</i> . . . . .	367
146	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. oxleyanus</i> . . . . .	367
147	SEM Showing pollen Grain Shape and Exine Sculpturing in <i>D. carinatus</i> . . . . .	367



148	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. lanceolatus</i> . . . . .	367
149	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. grandiflorus</i> . . . . .	367
150	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. graveolens</i> . . . . .	367
151	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. excelsus</i> . . . . .	368
152	SEM Showing a Close View of Exine Sculpturing in <i>D. excelsus</i> . . . . .	368
153	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. wyatt-smithii</i> . . . . .	368
154	SEM Showing a Close View of Exine Sculpturing in <i>D. wyatt-smithii</i> . . . . .	368
155	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. testudinarum</i> . . . . .	368
156	SEM Showing a Close View of Exine Sculpturing in <i>D. testudinarum</i> . . . . .	368
157	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. singaporensis</i> . . . . .	368
158	SEM Showing a Close View of Exine Sculpturing in <i>D. singaporensis</i> . . . . .	368
159	SEM Showing a Close View of Exine Sculpturing in <i>D. griffithii</i> . . . . .	368
160	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. griffithii</i> . . . . .	368
161	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. johoricus</i> . . . . .	368
162	SEM Showing a Close View of Exine Sculpturing in <i>D. johoricus</i> . . . . .	368
163	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. dulcis</i> . . . . .	369



164	SEM Showing a Close View of Exine Sculpturing in <i>D. macrophyllus</i> . . . . .	369
165	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. macrophyllus</i> . . . . .	369
166	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. zibethinus</i> . . . . . (Clone D24)	369
167	SEM Showing a Close View of Exine Sculpturing in <i>D. zibethinus</i> (Clone D24) . . . . .	369
168	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. zibethinus</i> (Clone Kop) . . . . .	369
169	SEM Showing a Close View of Exine Sculpturing in <i>D. zibethinus</i> (Clone Kop) . . . . .	369
170	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. zibethinus</i> (Clone KK2) . . . . .	369
171	SEM Showing a Close View of Exine Sculpturing in <i>D. zibethinus</i> (Clone KK2) . . . . .	369
172	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. zibethinus</i> (Clone D111) . . . . .	369
173	SEM Showing a Close View of Exine Sculpturing in <i>D. zibethinus</i> (Clone D111) . . . . .	369
174	SEM Showing Pollen Grain Shape and Exine Sculpturing in <i>D. zibethinus</i> (Clone D88) . . . . .	369
175	SEM Showing a Close View of Exine Sculpturing in <i>D. zibethinus</i> (Clone D88) . . . . .	369
176	<i>D. kutejensis</i> Fruit With Orange Aril . . . . .	370
177	<i>D. oxleyanus</i> Fruit Showing the White Aril . . . . .	370
178	<i>D. oxleyanus</i> Fruit With Long Conical Spines . . . . .	370
179	<i>D. graveolens</i> Fruit, Aril Partially Covering Seeds . . . . .	370
180	<i>D. graveolens</i> Showing the Split Fruit . . . . .	370



181	<i>D. zibethinus</i> Showing the Thick Yellow Aril . . . . .	370
182	<i>D. zibethinus</i> Fruits (D24) . . . . .	370
183	<i>D. carinatus</i> Showing the Red Aril . . . . .	371
184	<i>D. carinatus</i> Fruit . . . . .	371
185	<i>D. malaccensis</i> , Aril White, Partially Covered Seeds . . . . .	371
186	<i>D. malaccensis</i> Fruit . . . . .	371
187	<i>D. lowianus</i> Showing Yellow Aril . . . . .	371
188	<i>D. lowianus</i> Fruit . . . . .	371
189	<i>D. dulcis</i> , Red Pericarp and Yellow Aril . . . . .	372
190	<i>D. singaporensis</i> var. <i>jerangauensis</i> Persistent Epicalyx . . . . .	372
191	<i>D. singaporensis</i> var. <i>jerangauensis</i> Showing Brown Seeds With Pointed Apex, Without Aril . . . . .	372
192	<i>D. singaporensis</i> var. <i>jerangauensis</i> Showing the White Young Seeds . . . . .	373
193 & 194	<i>D. singaporensis</i> Showing Round, Lobed Fruit, With Persistent Calyx and Style; Brown Seeds Without Aril . . . . .	373
195	<i>D. singaporensis</i> Showing the White Young Seeds . . . . .	373
196	<i>D. griffithii</i> Showing an Opened Fruit With a Seed; Pericarp Red . . . . .	373
197	<i>D. griffithii</i> Showing Orange Aril Covering Only Basal Part of Seed; Seed Black and Shiny . . . . .	373
198, 200, 202	Variations in Pericarp Colour Within Edible <i>Durio</i> Species - <i>D. lowianus</i> . . . . .	374
199, 201, 203	Variations in Pericarp Thickness; Aril Colour and the Degree of Aril Covering the Seeds . . . . .	374
204	<i>D. graveolens</i> Showing Yellow Pericarp, Pink Aril and Dark Brown Seeds . . . . .	375



205	<i>D. graveolens</i> Showing Fruits With Green Pericarp; Dark Yellow and Orange Aril and Brown Seeds . . . . .	375
206 & 207	<i>D. graveolens</i> With Bark Yellow Spines and Dark Yellow Aril . . . . .	375
208	<i>D. kutejensis</i> Showing Various Fruit Shapes and Arils from Yellow to Dark Yellow to Orange Colour . . . . .	375
209	<i>D. singaporensis</i> - Short-Stalked Fruit on a Branch . . . . .	376
210	<i>D. lowianus</i> - Long-Stalked Fruit on a Branch . . . . .	376
211	<i>D. testudinarum</i> - Fruits on Bosses at the Base of Trunk . . . . .	376
212	<i>D. griffithii</i> - Fruit at the Axil of a Fallen Leaf on a Branch . . . . .	376
213	<i>D. graveolens</i> - Fruits on Branches . . . . .	376
214	<i>D. oxleyanus</i> Seeds . . . . .	377
215 & 220	<i>D. lowianus</i> Seeds . . . . .	377
216 & 223	<i>D. graveolens</i> Seeds . . . . .	377
217	<i>D. zibethinus</i> Seeds . . . . .	377
218	<i>D. singaporensis</i> Seeds . . . . .	377
219	<i>D. kutejensis</i> Seeds . . . . .	377
221	<i>D. singaporensis</i> var. <i>jerangauensis</i> Seeds . . . . .	377
222	<i>D. griffithii</i> Seeds . . . . .	377
224	<i>D. malaccensis</i> Seeds . . . . .	377
225	<i>D. dulcis</i> . . . . .	378
226	<i>D. carinatus</i> . . . . .	378
227	<i>D. macrophyllus</i> . . . . .	378
228	<i>D. oblongus</i> . . . . .	378
229	<i>D. griffithii</i> var. <i>acutifolius</i> . . . . .	378





230	<i>D. griffithii</i> . . . . .	378
231	<i>D. singaporensis</i> . . . . .	378
232	<i>D. affinis</i> . . . . .	378
233	<i>D. johorensis</i> . . . . .	378
234	<i>D. testudinarum</i> var. <i>testudinarum</i> . . . . .	379
235	<i>D. testudinarum</i> var. <i>macrophyllus</i> . . . . .	379
236	<i>D. pinangianus</i> . . . . .	379
237	<i>D. lanceolatus</i> . . . . .	379
238	<i>D. graveolens</i> . . . . .	379
239	<i>D. wyatt-smithii</i> . . . . .	379
240	<i>D. kutejensis</i> . . . . .	379
241	<i>D. lowianus</i> . . . . .	379
242	<i>D. grandiflorus</i> . . . . .	379
243	<i>D. kinabaluensis</i> . . . . .	379
244	<i>D. excelsus</i> . . . . .	379
245	Peltate Trichome (D24) . . . . .	380
246	Long Fimbriated Peltate Trichome (D24) . . . . .	380
247	Stellate Hairs with a Central Cushion (D24) . . . . .	380
248	Four-Armed Stellate Hair with a Central Cushion (D24) . . .	380
249	Stellate Hairs without a Central Cushion (D24) . . . . .	380
250	Arrangement of Trichomes on the Abaxial Leaf Surface (D2)	380
251	D2 - Dense Trichomes . . . . .	381
252	D10 - Dense Trichomes . . . . .	381
253	D24 - Dense Trichomes . . . . .	381

