

The Taxonomic Significance of Trichome Morphology in the Genus *Durio* (Bombacaceae)

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Abstract

Scanning electron microscopy was used to examine the trichome morphology on the leaves of 24 species of *Durio*. Glandular trichomes and non-glandular trichomes are present on the abaxial leaf surface. Stellate hairs can be found on the adaxial leaf surface of *D. affinis*, *D. graveolens*, *D. oblongus*, *D. oxleyanus*, *D. singaporensis* and *D. zibethinus*. Trichome morphology can be used to distinguish the *Durio* species studied. *D. carinatus* can be distinguished by the presence of only peltate scales on the abaxial leaf surface. The other species can be divided into three major groups based on the density and distribution of the peltate scales and stellate hairs.

Introduction

The genus *Durio* consists of 29 species, which are confined to tropical Southeast Asia (Kostermans, 1958) and distributed from Sri Lanka, India and Burma through Thailand, Peninsular Malaysia, Singapore, Borneo, Sumatra, the Philippines to New Guinea.

Earlier taxonomic accounts of the genus have been evaluated and revised based on their macromorphological characters (Beccari, 1889; King, 1891; Bakhuizen, 1924; Ridley, 1922; Corner, 1939; Wyatt-Smith, 1953; Kostermans, 1958; Kochummen, 1972; Cockburn, 1976 and Ashton, 1988). In *Durio* species, leaf morphology such as shape and size is variable even within a single species making it difficult to distinguish the species based on leaf characters alone (Kochummen, 1972; 1988). However, identification of *Durio* species based on leaf characters is important since the flowering and fruiting episodes are seasonal and for most of the year only sterile specimens are available.

Micromorphological characters of the leaf epidermis are increasingly being employed as a source of important diagnostic characters in taxonomic determination (Metcalf and Chalk, 1950; Stace, 1965, 1984). Baas (1972) studied the epidermal cells of *Kostermansia malayana*. *Durio* species exhibit a diversity of trichome types. All species bear several types of trichomes on leaves, stem and flowers. Nor Azian (1992) who studied leaf epidermis of eight *Durio* species revealed some diagnostic characters of trichomes

for their identification. The aim of the present study is to investigate the microscopic variability of trichome characters of the leaf surface and to assess their potential as taxonomic markers for *Durio* species.

Materials and Methods

Leaf samples from living plants as well as from herbarium materials of only 24 *Durio* species were available and used for this investigation (Table 1). A 5 mm² section of dry leaf lamina (adaxial and abaxial surfaces) was fixed onto double-sided adhesive tape on labelled stubs. The specimens were coated with gold paladium at 260° A, and scanned under JOEL JSM-35C scanning electron microscope at the Universiti Putra Malaysia.

A square of cellophane tape about 1 cm² was pressed on the abaxial leaf surface. It was then pulled free and pasted onto a glass slide. The morphological features of the scales were observed under a light microscope. Light microscope photographs were then taken.

Transverse sections of lamina were also made. Fresh samples were fixed immediately in 50% FAA (formalin, acetic acid, alcohol). Dried herbarium materials were revived in water at 60° C overnight. Specimens were then dehydrated, sectioned and stained with safranin O and fast green using the standard method (Sass, 1958).

Table 1: List of *Durio* species examined

Species	Herbarium specimen	Fresh specimen (Locality)
1. <i>D. affinis</i>	KEP 3945	
2. <i>D. carinatus</i>	FRI 3819	Rompin
3. <i>D. crassipes</i>	SAN 16810	
4. <i>D. dulcis</i>	SAN 15389	
5. <i>D. excelsus</i>	A 13513	
6a. <i>D. grandiflorous</i> var. <i>grandiflorus</i>	SAN 4611	
6b. <i>D. grandiflorus</i> var. <i>tomentosus</i>	S 39199	
7. <i>D. graveolens</i>	KEP 65525	Jerangau

Species	Herbarium specimen	Fresh specimen (Locality)
8a. <i>D. griffithii</i> var. <i>griffithii</i>	KEP 7344	Semenyih
8b. <i>D. griffithii</i> var. <i>acutifolius</i>	SAN 34716	
9. <i>D. johoricus</i>	MS 1674	
10. <i>D. kinabaluensis</i>	SAN 105554	
11. <i>D. kutejensis</i>	S 22848	
12. <i>D. lanceolatus</i>	SAN 15373	
13. <i>D. lowianus</i>		Serdang
14. <i>D. macrolepis</i>	Haniff 3700	
15. <i>D. macrophyllus</i>	KEP 2731	
16. <i>D. malaccensis</i>	KEP 64878	Semenyih
17. <i>D. oblongus</i>	S 43701	
18. <i>D. oxleyanus</i>	FRI 21576	Jerangau
19. <i>D. pinangianus</i>	KEP 3780	
20a. <i>D. singaporensis</i> var. <i>singaporensis</i>		Jerangau
20b. <i>D. singaporensi</i> var. <i>jerangauensis</i>	MAR 6529	
21a. <i>D. testudinarum</i> var. <i>testudinarum</i>	A 3101	
21b. <i>D. testudinarum</i> var. <i>crassifolius</i>	SAN 26217	
22. <i>D. perakensis</i>	KEP 28714	
23. <i>D. wyatt-smithii</i>	KEP 57451	Bt. Bauk, Dungun
24. <i>D. zibethinus</i>		Serdang

Results

The differences in shape, density and distribution of the trichomes are illustrated in Figures 1a-k; Plates 1a-f and 2a-r. Data on trichome characters are tabulated in Table 2. Two basic types of trichomes are found on the leaf of *Durio* species: (a) glandular and (b) non-glandular.

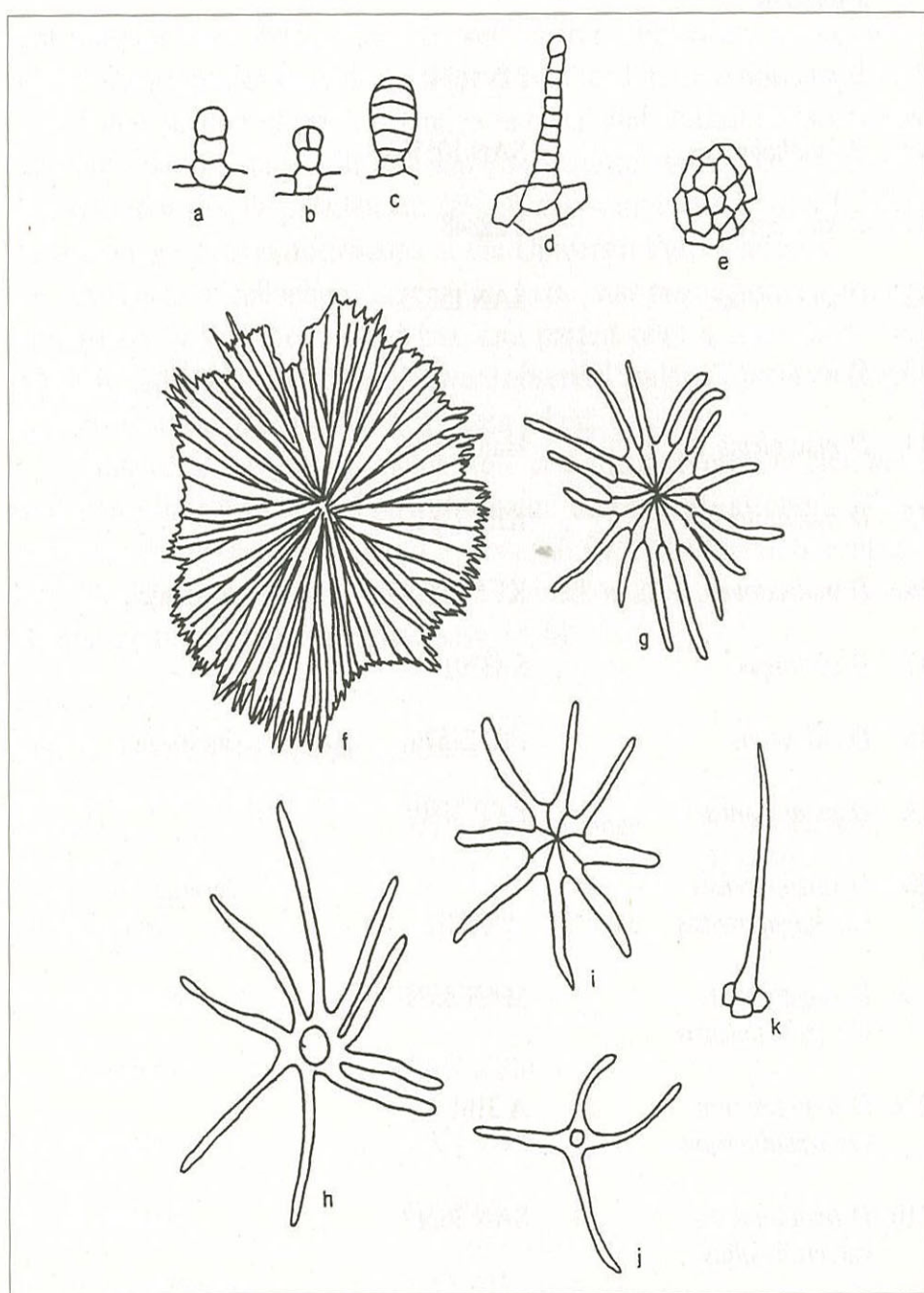


Figure 1. Types of trichomes. (a) Two-celled stalk with unicellular hemispherical glandular head; (b) Two-celled stalk with multicellular hemispherical glandular head; (c) One- to two-celled stalk with ovoid multicellular glandular head; (d) Uniseriate stalk with single-celled globular or hemispherical head; (e) Foot of peltate scale; (f) Complex peltate scale; (g) Simple peltate scale (h) Cushioned stellate hair; (i) Flat stellate hair; (j) Four-armed stellate trichome with a central cushion; (k) Simple non-glandular trichome

(a) Glandular trichomes

Glandular trichomes are found on the abaxial leaf surface of all *Durio* species and these can be divided into three categories. The first type is the glandular trichome with a one- or two- celled stalk and a hemispherical glandular head, which is unicellular or multicellular. In transverse section the short one-celled stalk has its foot embedded in the epidermal layer (Figs.1a-b) and the trichome base is supported by unmodified epidermal cells (Fig. 1e). This type of glandular trichomes occurs abundantly on the

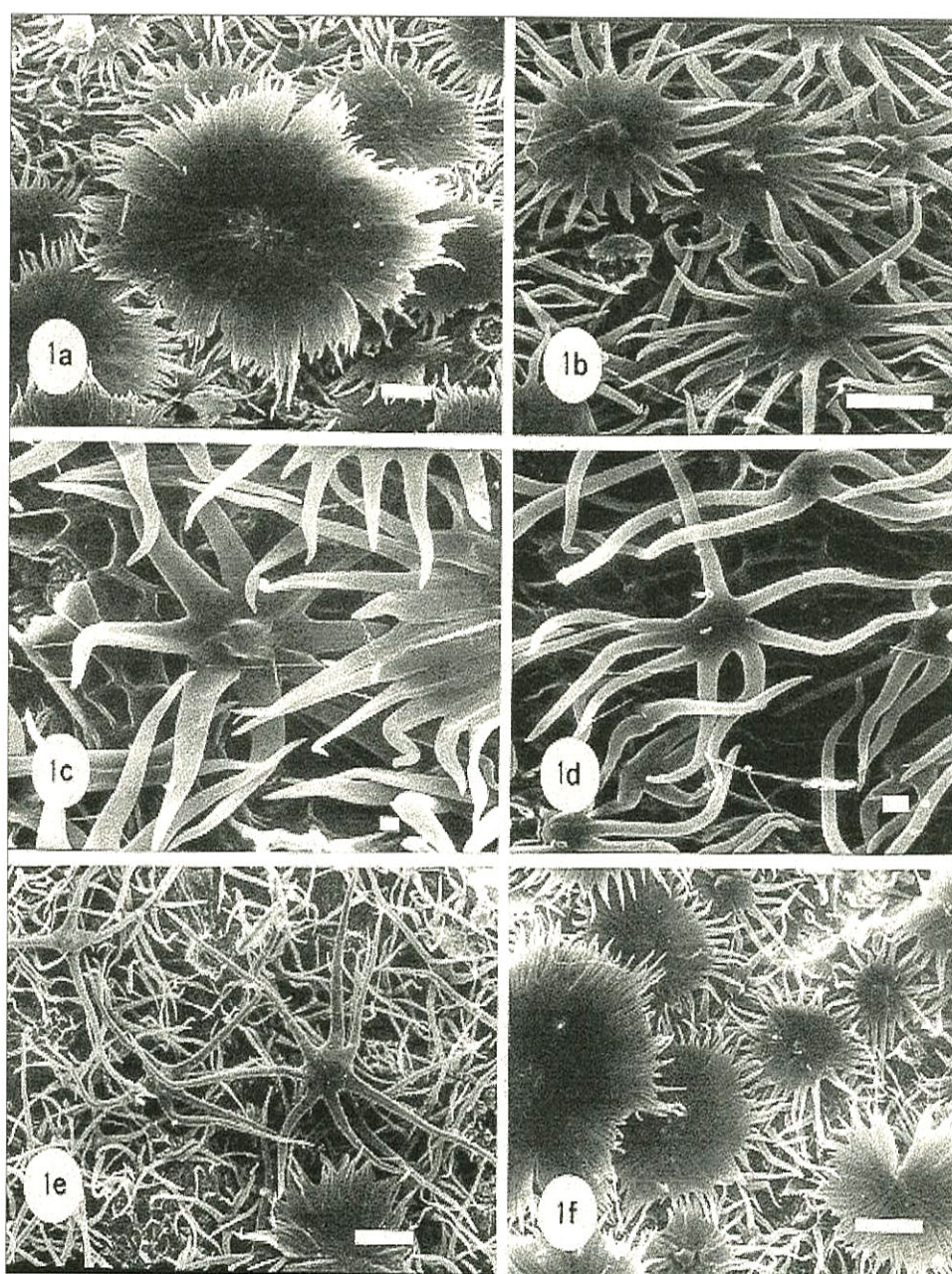


Plate 1. SEM micrographs of *Durio* trichomes showing their types and arrangement on the abaxial leaf surface. (a) Complex peltate scale; (b) Simple peltate scale; (c) Cushioned stellate hairs; (d) Flat stellate hairs; (e) Four-armed stellate trichomes with a central cushion; (f) Arrangement of trichomes on the abaxial leaf surface. Scale bar = 100µm.

abaxial leaf surface of all species.

The second type is the short-stalked trichome with a multicellular glandular head. This type of trichome has a one- or two-celled stalk and an ovoid multicellular glandular head (Fig. 1c). The base of the trichome is thickened with unmodified epidermal cells. This glandular trichome occurs in *D. affinis* and *D. carinatus*.

The third type is the long-stalked trichome with a hemispherical head consisting of a 2- to 9-celled uniseriate stalk terminating in a single-celled globular or hemispherical head (Fig. 1d). The foot may arise from the centre of the epidermal cell. The base of the trichome is thickened with unmodified epidermal cells. This type of glandular trichome is observed on the abaxial leaf surface of *D. dulcis*, *D. testudinarum* and *D. singaporensis*.

(b) Non-glandular trichomes

Non-glandular trichomes are observed on the abaxial leaf surface of all species and on the adaxial leaf surface of some species (Table 2; Plates 1 & 2). Six types of non-glandular trichomes are recognised:

(i) **Complex peltate scales** - sessile, foot uniseriate embedded in the epidermis, uniseriate, multicellular head delimited by primary and secondary radial walls, margin undulating, 3-5-lobed, or sometimes split, short- or long-fimbriated (Fig. 1f and Plate 1a). The trichome base is generally multicellular with polygonal, isodiametric, straight-walled cells (Fig. 1e). This type of scale occurs on the abaxial leaf epidermis of all species.

(ii) **Simple peltate scales** - sessile, foot uniseriate sunken in the epidermis, multicellular head delimited only by primary radial walls, margin strongly lobed, not split, long-fimbriated (Fig. 1g and Plate 1b), occurs in all species.

(iii) **Cushioned stellate hairs** - sessile, rays more than five with a central cushion (Fig. 1h and Plate 1c); occurs in all species except in *D. carinatus*.

(iv) **Flat stellate hairs** - stalked or sessile, rays more than five, without a central cushion (Fig. 1i and Plate 1d); occurs in all species except in *D. carinatus*.

(v) **Four-armed stellate trichome** - sessile with a central cushion (Fig. 1j and Plate 1e); occurs in all species except in *D. carinatus*

(vi) **Simple** - unicellular, long, tapered at the tip (Fig. 1k); occurs in *D. lowianus* and *D. singaporensis* var. *jerangauensis*.

In most species (except *D. oxleyanus*, *D. excelsus*, *D. perakensis*, *D. griffithii* var. *griffithii* and *D. grandiflorus* var. *tomentosus*), the two types of peltate scales form three to four layers while the stellate hairs, the four-

armed trichomes and all the glandular trichomes lie beneath them (Table 2; Plates 1f and 2a-r). In *D. oxleyanus*, *D. excelsus*, *D. perakensis*, *D. griffithii* var. *griffithii* and *D. grandiflorus* var. *tomentosus*, the abaxial leaf surface is densely covered with the two types of stellate hairs and four-armed trichomes with peltate scales scattered sparsely above them (Plate 2 e and l).

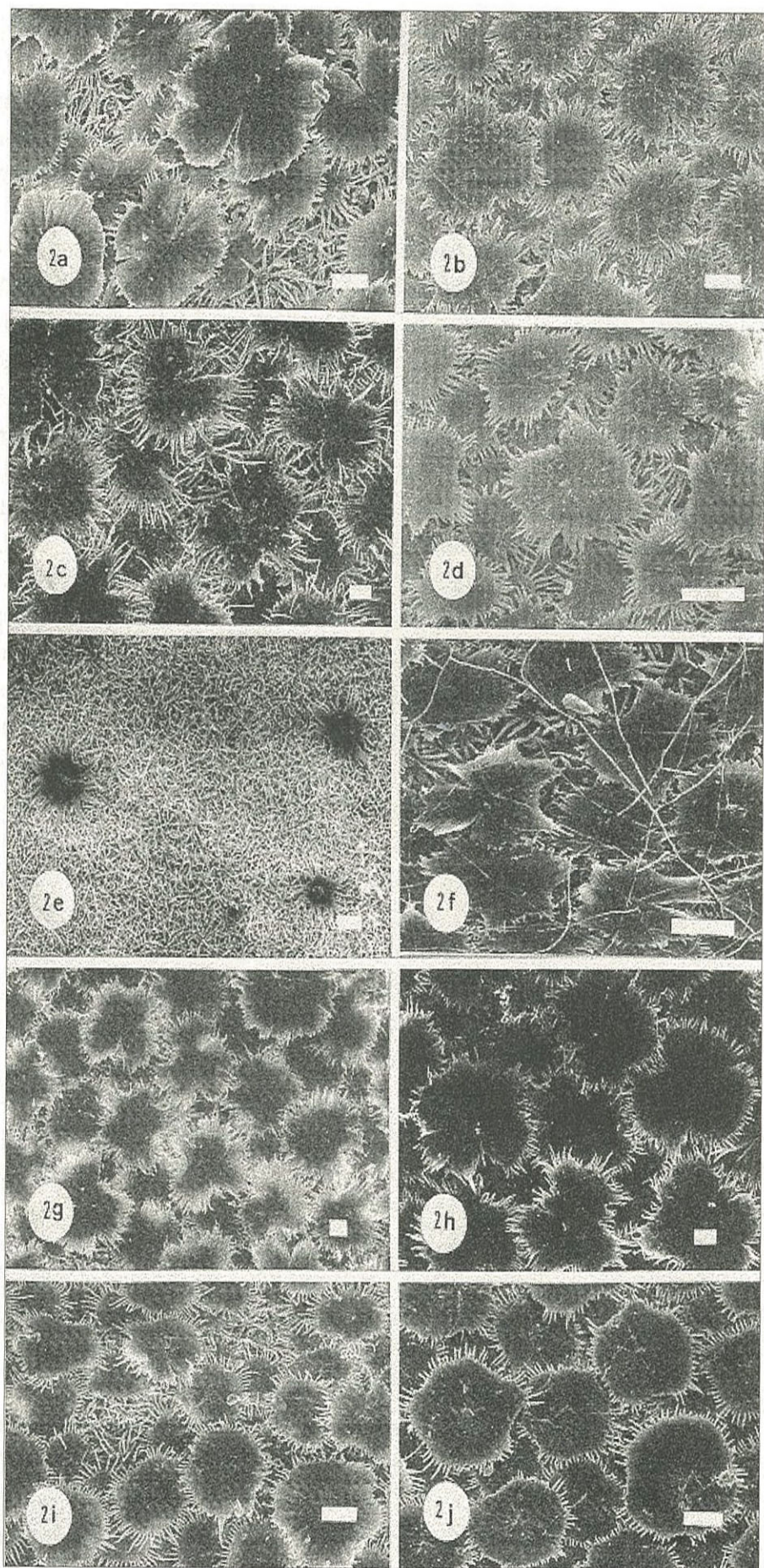
In some species, infraspecific variation of trichome characters is observed. There is variation in the density of the type of trichomes on the abaxial leaf surface of *D. griffithii* var. *griffithii* and *D. griffithii* var. *acutifolius*. There are dense stellate hairs indicated by (+++) with very few peltate scales (+) on the abaxial leaf surface of *D. griffithii* var. *griffithii* while in *D. griffithii* var. *acutifolius* there are dense peltate scales (+++) with dense stellate hairs (+++) underneath (Table 2). Similarly, in *D. grandiflorus* var. *grandiflorus* the abaxial leaf surface possesses dense peltate scales (+++) with dense stellate hairs (+++) underneath, while in *D. grandiflorus* var. *tomentosus* there are dense stellate hairs (+++) with a few peltate scales (+) scattered on top. *D. singaporensis* var. *jerangauensis* differs from *D. singaporensis* var. *singaporensis* by having simple unicellular trichomes on the abaxial leaf surface (Table 2). Whereas *D. testudinarum* var. *testudinarum* can be distinguished from *D. testudinarum* var. *crassifolius* by having a few long-stalked glandular trichomes with hemispherical head.

The shape of the outermost layer of the peltate scales varies between species. Thus, in *D. malaccensis* the peltate scales are almost round or have a slightly undulating margin, which is usually not split and is shortly fimbriated (Plate 2j), while in *D. macrophyllus* the peltate scales are deeply five-lobed and split and are distinctly fimbriated (Plate 2k). *D. pinangianus* possesses similar trichome characters as *D. malaccensis* except that its complex peltate scales are slightly lobed. However other leaf parameters such as leaf size, texture and venation patterns are different.

In most species the complex peltate scales are split except in *D. malaccensis*, *D. oxleyanus*, *D. testudinarum* var. *crassifolius*, *D. grandiflorus* var. *grandiflorus*, *D. griffithii* var. *acutifolius* and *D. johoricus* where the complex scales are mostly entire (Table 2).

The size of the outermost layer of complex peltate scales also varies between species. *D. graveolens*, *D. macrophyllus*, *D. oblongus* and *D. singaporensis* have large complex peltate scales with the mean diameter greater than 800 μ m (Table 2), whereas in *D. excelsus*, *D. griffithii* and *D. grandiflorus* the scales are smaller and less than 200 μ m in diameter.

The colour of the complex peltate scales on the abaxial surface of both fresh and dried laminae is distinct in certain species. Thus in *D. graveolens*, *D. singaporensis*, *D. macrophyllus*, *D. oblongus* and *D. kutejensis*, the complex peltate scales are dark golden brown while in other species the complex peltate scales are brown in colour.



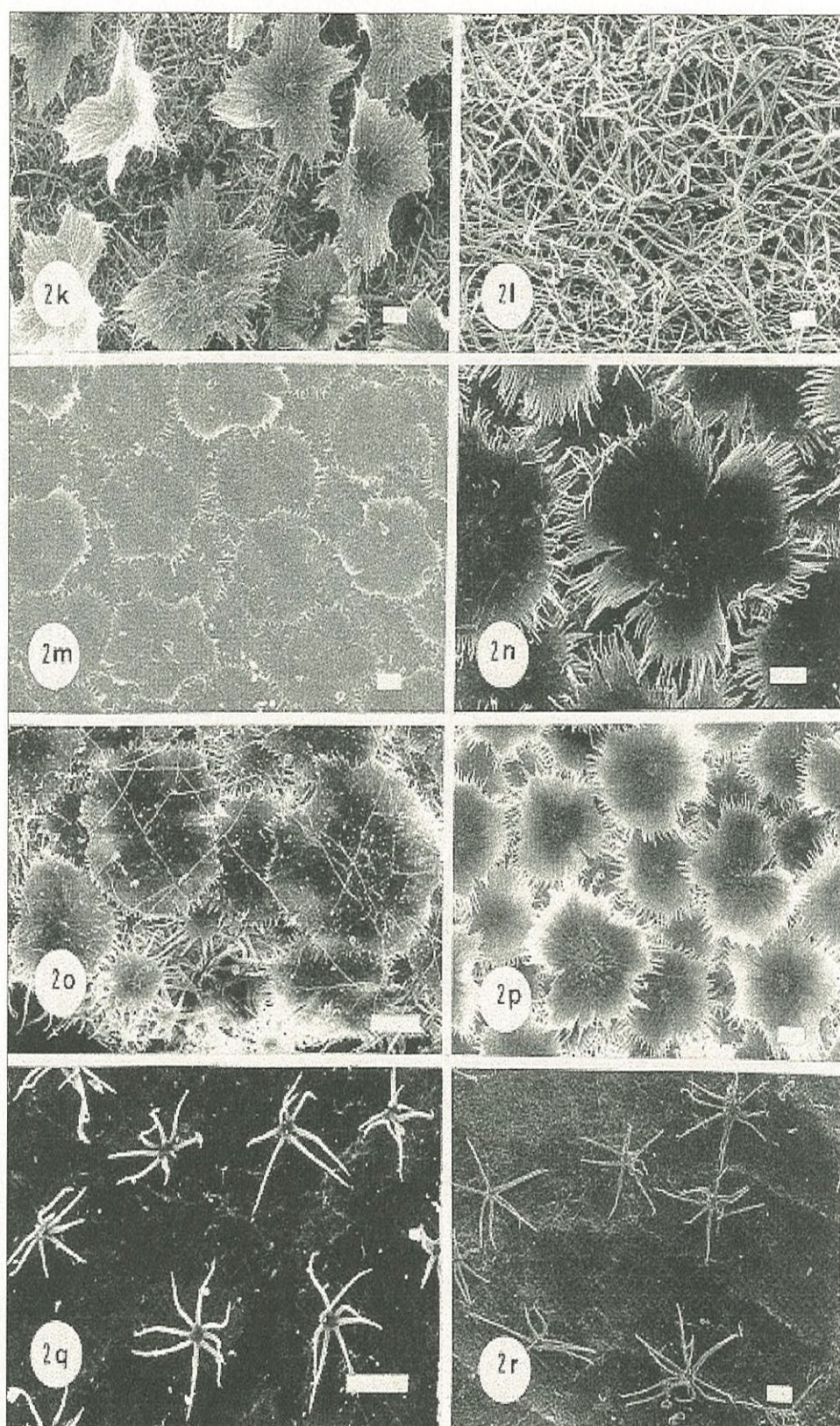


Plate 2. SEM micrographs showing trichome shapes and their distribution on the abaxial leaf surface of *Durio* species. (a) *D. affinis* (b) *D. carinatus* (c) *D. dulcis* (d) *D. grandiflorus* var. *grandiflorus* (e) *D. griffithii* var. *griffithii* (f) *D. griffithii* var. *acutifolius* (g) *D. graveolens* (h) *D. kutejensis* (i) *D. lowianus* (j) *D. malaccensis* (k) *D. macrophyllus* (l) *D. oxleyanus* (m) *D. pinangianus* (n) *D. singaporensis* (o) *D. testudinarum* (p) *D. zibethinus*; trichome shapes on the adaxial leaf surface. (q) *D. singaporensis* and (r) *D. graveolens*. Scale bar= 100µm.

Table 2: Leaf Trichome Characters of *Durio* Species

Characters	Occurrence of trichomes		Frequency of different types of non glandular trichomes						Frequency of different types of glandular trichomes			Shape of complex peltate scale	Diameter of complex peltate scale (µm)	Colour of complex peltate scale	Attachment of complex peltate scale
	Upper epidermis	Lower epidermis	1	2	3	4	5	6	1	2	3				
Species															
1. <i>D. affinis</i>	++	+++	+++	+++	+++	++	+++	-	++	++	-	round to 5-lobed, split	(458-)538(-615)	brown	adpressed
2. <i>D. carinatus</i>	-	+++	+++	++	-	-	-	-	++	++	-	slightly 4-5 lobed, split 1-2x, short-fimbriated	(395-)565(-631)	brown	adpressed
3. <i>D. crassipes</i>	-	+++	+++	+++	++	+	+	-	++	-	-	4-5 lobed, split 1-2x, long-fimbriated	(395-)436(-473)	brown	adpressed
4. <i>D. dulcis</i>	-	+++	++	++	+++	++	+++	+	++	-	+	3-4 lobed, split 1-3x, v. long-fimbriated	(592-)686(-789)	brown	adpressed
5. <i>D. excelsus</i>	-	+++	+	+	+++	+++	+++	-	++	-	-	round, not split, long-fimbriated	(95-)117(-134)	brown	adpressed
6. <i>D. grandiflorus</i> var. <i>grandiflorus</i>	-	+++	+++	++	+++	++	++	-	++	-	-	4-5 lobed, not split, very long-fimbriated	(142-)191(-213)	brown	adpressed
6a. <i>D. grandiflorus</i> var. <i>tomentosus</i>	-	++	+	+	+++	+++	+++	-	++	-	-	lobed, split, very short-fimbriated	(197-)205(-236)	brown	adpressed
7. <i>D. graveolens</i>	+/-	+++	+++	+++	+++	+++	+++	++	++	-	-	4-5 lobed, split 1-4x, long-fimbriated	(868-)994(-1184)	dark, golden brown	loose
8a. <i>D. griffithii</i> var. <i>griffithii</i>	-	+++	+	+	+++	++	+++	-	++	-	-	5 lobed, split 1x, very long-fimbriated	(63-)96(-110)	brown	adpressed
8b. <i>D. griffithii</i> var. <i>acutifolius</i>	-	+++	+++	+++	+++	+++	+++	-	++	-	-	round to slightly lobed, long-fimbriated	(316-)395(-473)	brown	adpressed
9. <i>D. johoricus</i>	-	+++	+++	+++	+++	++	++	-	++	-	-	round to slightly undulating edge, not fimbriated	(355-)409(-481)	brown	adpressed
10. <i>D. kinabaluensis</i>	-	+++	+++	+++	+++	+++	+++	++	++	-	-	5 lobed, split 1-2x, very long fimbriated	(552-)590(-671)	brown	adpressed

Table 2 (Cont'd)

Characters	Occurrence of trichomes		Frequency of different types of non glandular trichomes						Frequency of different types of glandular trichomes			Shape of complex peltate scale	Diameter of complex peltate scale (µm)	Colour of complex peltate scale	Attachment of complex peltate scale	
Species	Upper epidermis	Lower epidermis	1	2	3	4	5	6	1	2	3					
11. <i>D. kutejensis</i>	-	+++	+++	+++	+++	+++	+++	+++	++	-	-	4-5 lobed, split 1-2x, long-fimbriated	(473-)555(-647)	dark, golden brown	adpressed	
12. <i>D. lanceolatus</i>	-	+++	+++	+++	+++	+++	+++	++	++	-	-	4-5 split 1-3x, long-fimbriated	(395-)460(-552)	brown	adpressed	
13. <i>D. lowianus</i>	-	+++	+++	+++	+++	+++	+++	+++	++	+	-	4-5 lobed, split, long-fimbriated	(434-)510(-631)	brown	adpressed	
14. <i>D. macrolepis</i>	-	+++	+++	++	++	++	++	++	++	-	-	3-5 lobed, split 1-2x, short-fimbriated	(750-)817(-868)	brown	loose	
15. <i>D. macrophyllus</i>	-	++	++	++	+++	+++	+++	++	++	-	-	5-lobed, split 1-3x, very long-fimbriated	(552-)589(-631)	brown	loose	
16. <i>D. malaccensis</i>	-	+++	+++	+++	+++	++	+++	+++	++	-	-	round to slightly undulating edge, not split, short-fimbriated	(458-)515(-631)	brown	adpressed	
17. <i>D. oblongus</i>	++	+++	+++	+++	+++	+++	+++	+++	++	-	-	3-5 lobed, split 1-3x, long-fimbriated	(631-)807(-1168)	dark, golden brown	adpressed	
18. <i>D. oxleyanus</i>	++	+++	+	+	+++	+++	+++	+++	++	-	-	round, not split, short-fimbriated	(473-)624(-718)	brown	loose	
19. <i>D. pinangianus</i>	-	+++	+++	+++	+++	++	++	++	++	-	-	3-5 lobed, not split, short-fimbriated	(418-)466(-552)	brown	adpressed	
20a. <i>D. singaporensis</i> var. <i>singaporensis</i>	++	+++	+++	+++	+++	+++	+++	+++	++	-	+	3-5 lobed, not split, short-fimbriated	(592-)712(-789)	dark, golden brown	adpressed	
20b. <i>D. singaporensis</i> var. <i>jerangauensis</i>	++	+++	+++	+++	+++	+++	+++	+++	++	+	+	3-5 lobed, split 1-3x, long-fimbriated	(552-)607(-831)	brown	adpressed	
21a. <i>D. testudinarius</i>	-	+++	+++	+++	+++	+++	+++	+++	++	-	+	5 lobed, not split, long-fimbriated	(434-)518(-631)	brown	adpressed	

Table 2 (Cont'd)

Species	Occurrence of trichomes		Frequency of different types of non glandular trichomes						Frequency of different types of glandular trichomes	Shape of complex peltate scale	Diameter of complex peltate scale (µm)	Colour of complex peltate scale	Attachment of complex peltate scale
	Upper epidermis	Lower epidermis	1	2	3	4	5	6					
21b. <i>D. testudinarium</i> var. <i>crassifolius</i>	-	+++	+++	+++	+++	++	++	-	++	5 lobed, undulating, short-fimbriated	(395-)439(-473)	brown	loose
22. <i>D. perakensis</i>	-	++	-	+	+++	+++	+++	-	++	5-lobed, split 1-3x, very long-fimbriated	-	brown	-
23. <i>D. wyatt-smithii</i>	-	+++	+++	+++	+++	+++	+++	-	++	5-lobed, split 1x, long-fimbriated	(395-)452(-513)	brown with black centre	adpressed
24. <i>D. zibethinus</i>	-/+	+++	++/+ +++	+++	+++	+++	+++	-	++	3-5 lobed, split 1x, short-fimbriated	(552-)587(-631)	brown	adpressed

Keys: +++ dense intermediate
 ++ few
 + absent
 -

Types of non glandular trichomes (Refer to figure 1)

- 1 - complex peltate scale
- 2 - simple peltate scale
- 3 - cushioned stellate hair
- 4 - flat stellate hair
- 5 - four-armed stellate trichome
- 6 - simple unicellular trichome

Types of non glandular trichomes (Refer to figure 1)

- 1 - one or two celled stalk with a hemispherical glandular head
- 2 - short-stalked with multicellular glandular head
- 3 - long-stalked with hemispherical head

In most species, the trichomes on the abaxial leaf surface are appressed but in *D. graveolens*, *D. macrophyllus* and *D. macrolepis* the trichomes are loosely attached, and the veins beneath them can clearly be seen when the trichomes are removed.

On the adaxial leaf surface of *D. affinis*, *D. graveolens*, *D. oblongus*, *D. oxleyanus*, *D. singaporensis* and *D. zibethinus*, the only trichomes present are the sessile stellate hairs with more than five rays, and without a cushion (Plates 2q and 2r).

Discussion and Conclusion

In general, the types of trichome present on the abaxial leaf surface of all species are similar except for the presence of simple, non glandular trichomes in *D. lowianus*, the long-stalked glandular trichome in *D. dulcis*, *D. kutejensis* and *D. singaporensis*, and the multicellular-headed glandular trichome in *D. affinis* and *D. carinatus*. Nor Azian (1992), who studied the anatomy of eight *Durio* species, i.e. *D. oxleyanus*, *D. zibethinus*, *D. lowianus*, *D. kutejensis*, *D. malaccensis*, *D. graveolens*, *D. singaporensis* and *D. griffithii*, also observed the presence of glandular and non-glandular trichomes on the abaxial leaf surface. However, she reported the presence of only two types of glandular trichomes, unicellular and multicellular uniseriate-stalked types. She did not report the presence of multicellular glandular trichomes in *D. griffithii* nor the presence of simple trichomes in *D. lowianus*. Density of the glandular trichomes is not a useful character to distinguish the species.

Differences exist between the *Durio* species for density and distribution of non-glandular trichomes. This was also noted by Nor Azian (1992). Among trichome characters, the distribution and density of non-glandular trichomes overall provide the most useful taxonomic character in the identification of sterile *Durio* specimens. Based on the distribution and density of the peltate scales and stellate hairs infraspecific variation can be determined. *D. griffithii* var. *acutifolius* and *D. grandiflorus* var. *grandiflorus* can be distinguished from *D. griffithii* var. *griffithii* and *D. grandiflorus* var. *tomentosus*, respectively by having dense peltate scales on the abaxial leaf surface whereas very few complex peltate scales present on the abaxial leaf surface of the latter two varieties. *D. singaporensis* var. *jerangauensis* is differentiated from *D. singaporensis* var. *singaporensis* in the presence of simple unicellular trichome.

The shape of the peltate scales in the outermost layer also provides a useful character in distinguishing some species as they show differences in shape and size. *D. malaccensis* is significantly different in having almost

circular and shortly fimbriated peltate scales while *D. macrophyllus* can be recognised by its deeply lobed, 4–5-split, long-fimbriated peltate scales. Although this character has not been used in the identification of the species before, it can provide a good supplementary character in some species particularly *D. malaccensis* and *D. macrophyllus*.

Another good trichome character is the mode of trichome attachment to the surface of the leaf. The loose attachment of the trichomes in species, such as *D. graveolens*, *D. macrophyllus* and *D. macrolepis*, also contributes an important criterion for recognising these species.

In most species the colour of the peltate scales on the abaxial leaf surface is brown. However, in certain species, such as *D. graveolens* and *D. macrophyllus*, the dark coppery brown colour of the peltate scales provides an important diagnostic character for their identification.

The presence of stellate hairs on the adaxial leaf surface is also an important character, which can be used to distinguish some species, such as *D. affinis*, *D. graveolens*, *D. oblongus*, *D. oxleyanus*, *D. singaporensis* and individuals of *D. zibethinus*.

Based on density and distribution of trichomes on the adaxial leaf epidermis, *D. carinatus* can be distinguished by having only peltate scales. The other *Durio* species can be divided into three broad groups: (i) species with a dense layer of stellate hairs with sparse peltate scales (such as *D. griffithii* var. *griffithii*, *D. grandiflorus* var. *tomentosus*, *D. oxleyanus*, *D. perakensis* and *D. excelsus*); (ii) species with dense stellate hairs with peltate scales moderately scattered above them, exposing stellate hairs beneath (e.g. *D. dulcis*, *D. graveolens*, *D. macrophyllus*, *D. macrolepis* and some individuals of *D. zibethinus*); and (iii) the remaining species which have dense stellate hairs and dense peltate scales.

The use of a combination of all the trichome characters enables the identification of most species as well as distinguishing species at infraspecific level. Based on trichome characters of the abaxial leaf surface, species in the first group one are distantly related to groups two and three, which are closely related. The results of SEM study on the micromorphological characters of the leaf surface support those obtained in the earlier study based on macromorphological characters (Salma, 1996).

Leaf surface characters are under strong genetic control and are little affected by the environment. Trichome structures are useful for the delimitation of the *Durio* species. It can be concluded that these characters provide significant systematic value for distinguishing *Durio* species.

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