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Structure, Ontogeny, Classification, and Taxonomic Significance of Trichomes in Malvales

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ABSTRACT

Structure, ontogeny, classification and taxonomic significance of trichomes have been studied in 39 genera and 125 species of the selected families in Malvales. They were studied on both vegetative and floral organs. There are nine types of eglandular and eight of glandular trichomes. The trichomes were classified on the basis of their form, structure and contents. All of them originated from a single papillate hair initial. According to the trichome data, the Malvales was confirmed as a natural order with 5 homogenous families: Malvaceae, Bombacaceae, Sterculiaceae, Tiliaceae, and Elaeocarpaceae.

INTRODUCTION

Metcalfe and Chalk (1950) reported ten types of glandular and eglandular trichomes in the families of the order Malvales. Inamdar and Chohan (1969 a, b) reported six types of trichomes in the 18 species studied of the Malvaceae and Bombacaceae. Ramayya and Rao (1976) and Rao and Ramayya (1977) studied trichomes in some species of the Malvaceae. It is evident from the above mentioned reports that only a handful of workers have studied the trichomes in the Malvaceae of the entire order Malvales and, therefore, the present investigation is undertaken with two views in mind: (1) to fill in this gap in our knowledge and (2) to see whether the trichomes form a taxonomic characters.

MATERIALS AND METHODS

The material of 125 species for the present study was collected from different parts of India and "Botanischer Garten and Botanisches Museum" Berlin-Dehlem, Berlin (see Table 1). These specimens were preserved in our laboratory, Department of Biosciences, Sardar Patel University. The epidermal peels from vegetative and floral organs of fresh and F.A.A. fixed materials were made and stained with Delafield's haematoxylin, washed in distilled water and mounted in glycerin jelly. Camera lucida was used for drawing

at table level. Various plant organs, such as leaf, stem, petiole, stipule, peduncle, pedicel, epicalyx, calyx, corolla, androecium, and gynoccium were examined.

Details of species-wise distribution of trichome types were shown in Table 1. Table regarding organographic distribution of trichome types in vegetative and floral organs was omitted for the sake of brevity. Any researcher interested in such a table can obtain from the authors.

Table 1. Distribution pattern of various trichome types in the Malvales

A, simple; B, hooked; C, conical; D, papillate; E, simple filiform; F, tufted; G, stellate with unicellular arms; H, stellate with multicellular arms; I, cylindrical glandular; J, uniseriate glandular with unicellular stalk; K, capitate glandular with unicellular stalk; L, fusiform glandular with unicellular stalk; M, clavate glandular with unicellular stalk; N, fusiform glandular with uniseriate stalk; O, capitate glandular with uniseriate stalk; P, fusiform glandular with biseriate stalk; Q, peltate scale; c, common; o, occasional; and r, rare.

Species No.	Name of taxa/trichome type	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
	Malvaceae																	
1	*Abelmoschus esculentus* W. & A.	c	—	o	—	—	—	o	—	—	—	—	—	—	—	—	c	—
2	*A. manihot* L.	o	—	o	—	c	—	r	—	—	r	—	—	r	—	—	c	—
3	*Abutilon album* Hort.	r	—	—	—	—	—	o	—	—	—	r	—	—	—	—	—	—
4	*A. crispum* G. Don	c	—	—	—	—	—	c	—	—	—	r	—	—	—	—	—	—
5	*A. glaucum* G. Don	r	—	—	—	—	—	c	—	—	—	—	—	r	—	—	—	—
6	*A. hybridum* Voss. cv. *Golden Fleece*	o	—	—	—	r	—	c	—	—	—	—	—	—	—	—	—	—
7	*A. indicum* G. Don	o	—	c	—	o	—	c	—	—	—	r	—	—	—	—	—	—
8	*A. megapotamicum* St. Hil. & Naud.	r	—	r	—	r	—	o	—	—	—	o	—	o	—	r	—	—
9	*A. milleri* Hort.	r	—	—	—	r	—	c	—	—	—	r	—	—	—	—	—	—
10	*A. muticum* G. Don	c	—	—	—	—	—	c	—	—	—	o	—	—	—	—	—	—
11	*A. pictum* Walp.	c	—	—	—	—	—	c	—	—	—	o	o	r	—	—	—	—
12	*A. polyandrum* Schlecht.	c	—	—	—	—	—	c	—	—	—	r	—	r	—	—	—	—
13	*Adansonia digitata* L.	o	—	r	—	—	—	—	—	—	—	—	—	r	—	—	—	—
14	*Althea rosea*(L.) Cav.	o	—	—	—	r	—	c	r	—	r	r	—	r	—	—	—	—
15	*Bombax malabaricum* DC.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16	*Ceiba pentandra* Gaertn.	r	—	—	—	—	—	r	—	—	—	r	—	r	—	—	—	—
17	*Decaschistia crotonifolia* W. & A.	o	—	—	—	—	—	c	—	—	—	r	—	r	—	—	—	—
18	*Gossypium barbadense* L.	c	—	—	—	—	—	c	—	—	—	r	—	r	—	—	—	—
19	*G. hirsutum* L.	c	—	—	—	—	—	c	r	—	—	—	—	—	—	—	—	—
20	*Hibiscus abelmoschus* L.	c	—	—	—	—	—	—	—	—	—	r	—	o	—	—	—	—
21	*H. angulosus* Stud.	o	—	—	—	r	—	r	r	—	r	r	—	r	—	—	—	—
22	*H. arnottianus* Gray	r	—	—	—	r	—	r	r	—	—	o	c	o	—	—	—	—
23	*H. caesius* Garcke	r	—	—	—	r	—	r	—	—	—	r	—	r	—	—	—	—
24	*H. canescens* Heyne	c	—	—	—	r	—	c	r	—	—	r	—	r	—	—	—	—

(continued)

Species No.	Name of taxa/trichome type	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
25	*Hibiscus cannabinus* L.	o	—	o	—	r	—	r	—	—	r	r	—	r	—	—	—	—
26	*H. ficulneus* L.	c	—	—	—	—	—	r	r	—	—	c	—	—	—	r	—	—
27	*H. furcatus* Roxb.	r	—	—	—	r	—	—	—	—	—	r	—	r	—	—	—	—
28	*H. lampas* Cav.	c	—	—	—	r	—	r	—	—	—	r	—	o	—	—	—	—
29	*H. lunariifolius* Gray	c	—	—	—	r	—	c	r	—	—	r	—	r	—	—	—	—
30	*H. micranthus* L.	r	—	r	—	—	—	r	r	—	r	—	—	—	—	—	—	—
31	*H. mutabilis* L.	r	—	—	—	—	—	c	r	—	—	o	c	r	r	—	r	—
32	*H. palmatus* Forsk.	—	—	—	—	—	—	—	—	—	—	r	—	r	—	—	—	—
33	*H. panduraeformis* Burm.	r	—	—	—	r	—	o	—	—	o	o	—	o	—	—	—	—
34	*H. platanifolius* Sweet	c	—	—	—	r	—	r	—	—	—	r	—	r	—	—	—	—
35	*H. punctatus* Dalz.	—	—	—	—	—	—	r	—	—	—	r	—	o	—	—	—	—
36	*H. radiatus* Willd.	—	—	—	—	—	—	r	—	—	—	o	—	r	—	—	—	—
37	*H. rosa-sinensis* L.	c	—	—	—	—	—	r	—	—	—	r	—	r	—	—	—	—
38	*H. sabdariffa* L.	c	r	—	—	r	—	o	r	—	—	r	c	r	—	—	—	—
39	*H. schizopetalus* Hook.	c	—	o	r	r	c	r	r	r	—	o	—	r	—	—	—	—
40	*H. solandra* L'Her.	c	c	—	o	—	—	c	—	—	—	r	—	o	—	o	—	—
41	*H. surattensis* L.	r	—	—	—	r	—	r	—	—	—	—	—	—	—	—	—	—
42	*H. syriacus* L. var. *varicgata* Hook.	c	—	—	—	—	—	o	—	—	—	o	c	r	—	—	—	—
43	*H. trionum* L.	r	—	r	—	o	—	o	—	—	—	r	c	o	—	—	—	—
44	*H. vitifolius* L.	o	—	—	—	—	—	o	—	—	—	—	—	r	—	—	—	—
45	*Kydia calycina* Roxb.	r	—	—	—	—	—	c	r	—	—	r	—	r	—	—	—	—
46	*Malachra capitata* L.	o	—	—	—	r	—	c	—	r	—	r	o	c	—	—	—	—
47	*Malva alcea* L.	o	—	r	—	—	—	—	—	—	—	r	—	r	—	—	—	—
48	*M. neglecta* Wallr.	r	—	—	—	—	—	r	—	—	—	r	—	r	—	—	—	—
49	*M. nicacensis* All.	c	—	r	—	—	—	r	—	—	—	r	—	r	—	—	—	—
50	*M. parviflora* L.	r	—	r	—	—	—	c	r	—	—	r	—	c	—	—	—	—
51	*M. parviflora* L. var. *oxyloba*(Boiss.) H. Krist.	r	—	—	—	r	—	r	—	—	—	r	—	r	—	—	—	—
52	*M. verticillata* L. var. *crispa* L.	r	—	—	—	—	—	—	—	—	—	—	—	r	—	—	—	—
53	*M. reticullata* var. *chinensis*(Mill.) Danert	r	—	—	—	—	—	r	—	—	—	r	—	r	—	—	—	—
54	*M. reticillata* var. *neuroloma* Schlechtd.	r	—	—	—	—	—	r	—	—	—	r	—	r	—	—	—	—
55	*Malvastrum coramandelianum*(L.) Garcke	r	—	—	—	r	—	r	—	—	—	—	—	—	—	—	—	—
56	*Malvaviscus arboreus* Cav.	r	—	o	—	—	—	r	—	—	—	—	—	—	—	—	—	—
57	*Modiola caroliniana*(L.) G. Don	r	—	—	—	r	—	—	—	—	—	—	—	—	—	—	—	—
58	*Pavonia coxii* Tad & Jack	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
59	*P. odorata Willd.*	o	—	—	—	—	—	c	—	—	—	r	—	o	—	—	—	—
60	*P. procumbens* Boiss.	o	—	—	—	—	—	c	—	—	—	—	—	r	—	—	—	—
61	*P. zeylanica* Cav.	—	—	—	—	—	—	r	—	—	o	o	o	c	—	—	—	—

(continued)

Species No.	Name of taxa/trichome type	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
62	*Senra incana* Cav.	c	—	—	—	r	—	c	—	—	—	r	—	r	—	—	—	—
63	*Sida acuta* Burm.	r	—	—	c	—	—	o	—	—	—	r	—	o	—	—	—	—
64	*S. cordata*(Burm.) Boiss.	c	—	—	—	r	—	c	—	—	—	r	r	o	—	—	—	—
65	*S. cordifolia* L.	r	—	—	—	r	—	c	r	—	—	—	—	r	—	—	—	—
66	*S. glutinosa* Cav.	c	—	—	—	r	c	c	—	c	—	—	—	—	—	—	—	—
67	*S. grewioides* Guill. & Perr.	c	—	—	—	r	—	c	—	—	—	r	—	r	—	—	—	—
68	*S. hermaphrodita*(L.) Rusby	—	—	—	—	—	—	—	—	—	—	r	—	c	—	—	—	—
69	*S. rhombifolia* L.	c	—	—	—	—	—	o	—	—	—	r	—	o	—	—	—	—
	a) *S. rhombifolia* var. *rhomboidea*	o	—	—	—	—	—	o	—	—	—	r	—	o	—	—	—	—
70	*S. schimperiana* Hochst.	o	—	—	—	—	—	c	—	—	—	—	—	r	—	—	—	—
71	*S. spinosa* L.	c	—	r	—	r	—	r	—	—	—	r	o	o	—	—	—	—
72	*S. triloba* Cav.	—	—	—	—	—	—	—	—	—	—	r	—	c	—	—	—	—
73	*S. veronicaefolia* Lam.	c	r	o	—	r	—	o	—	—	—	r	—	r	—	—	—	—
74	*Thespesia populnea* Corr.	c	—	—	—	—	—	r	—	—	—	—	—	r	—	—	—	c
75	*Urena sinuata* L.	r	r	—	—	—	—	o	—	—	—	r	—	c	—	—	—	—
	Sterculiaceae																	
1	*Cola acuminata* Schott & Endl.	o	—	—	—	—	—	r	—	—	—	—	—	r	—	—	—	—
2	*Dombeya natalensis* Sond.	r	—	—	—	r	—	c	—	—	—	—	—	r	—	—	—	—
3	*D. punctata* Cav.	r	—	r	—	—	c	c	—	—	—	r	r	o	—	—	—	—
4	*D. spectabilis* Bojer.	—	—	—	—	c	—	—	c	—	—	—	—	r	—	—	—	—
5	*D. wallichii* Dandon Jackson	—	—	—	—	c	—	—	c	—	—	—	—	r	—	—	—	—
6	*Eriolaena quinquelocularis* Wight	c	—	—	—	—	—	—	o	—	—	—	—	—	—	—	—	—
7	*E. stocksii* Hook.	c	—	—	—	—	—	c	r	—	—	—	—	r	—	—	—	—
8	*Guazuma tomentosa* Kunth	c	—	c	—	—	—	r	—	—	o	—	r	r	—	—	—	—
9	*Helecterea isora* L.	o	—	—	—	—	—	c	c	—	—	r	—	o	—	—	—	—
10	*Kleinhovia hospita* L.	c	r	—	—	o	—	—	—	—	—	—	—	—	—	—	—	—
11	*Melochia corchorifolia*	c	—	—	—	—	—	r	—	—	r	r	—	c	—	—	—	—
12	*Pentapetes phoenicea* L.	r	—	—	—	o	—	o	—	—	—	r	—	o	—	—	—	—
13	*Pterospermum acerifolium* Willd.	o	—	—	—	—	—	c	o	—	—	r	—	r	—	—	—	—
14	*P. heyneanum* Wall.	r	—	—	—	—	—	c	—	—	—	—	—	—	—	—	—	—
15	*P. suberifolium* Lam.	o	—	—	—	—	—	c	—	—	—	—	—	—	—	—	—	—
16	*Sterculia belanghas* L.	—	—	—	—	o	—	r	—	—	—	—	—	r	—	—	—	—
17	*S. coecinea* Roxb.	c	—	—	—	c	—	c	—	—	—	—	—	—	—	—	—	—
18	*S. colorata* Roxb.	r	—	—	—	—	—	c	—	—	—	—	—	—	—	—	—	—
19	*S. diversifolia* G. Don	—	—	—	—	—	—	—	—	—	—	—	—	r	—	—	—	—
20	*S. foetida* L.	—	—	—	—	o	—	c	—	—	—	—	—	—	—	—	—	—
21	*S. urens* Roxb.	r	—	—	—	—	—	—	—	—	—	—	—	r	—	—	—	—
22	*Theobroma canao* L.	o	r	r	—	—	—	c	—	—	—	r	—	o	—	r	—	—

(continued)

Species No.	Name of taxa/trichome type	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
23	*Waltheria indica* L	r	—	—	—	—	—	c	—	—	—	r	—	r	—	—	—	—
	Tiliaceae																	
1	*Berrya ammonilla* Roxb.	r	—	—	—	—	—	r	—	—	—	—	—	—	—	—	—	—
2	*Corchorus sesluana Ham.*	c	—	—	—	—	—	—	—	—	—	r	—	c	—	—	—	—
3	*C. antichorus* Roeusch.	c	—	—	—	—	—	—	—	—	—	r	—	o	—	—	—	—
4	*C. capsularis* L.	c	o	o	—	—	—	—	—	—	—	r	—	o	—	—	—	—
5	*C. depressus*(L.) Stocks	r	—	—	—	—	—	—	—	—	—	r	—	r	—	—	—	—
6	*C. fascicularis* Lam.	r	—	—	—	—	—	—	—	—	—	r	—	o	—	—	—	—
7	*C. olitorius* L.	r	—	r	—	—	—	—	—	—	—	r	—	o	—	—	—	—
8	*C. tridens* L.	r	—	—	—	—	—	—	—	—	—	r	—	r	—	—	—	—
9	*C. trilocularis* L.	r	—	—	—	—	—	—	—	—	—	r	—	o	—	—	—	—
10	*Elaeocarpus serratus* L.	o	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11	*Grewia abutifolia* Juss.	c	—	—	—	—	—	c	—	—	—	r	—	r	—	—	—	—
12	*G. asiatica* L.	r	—	—	—	c	—	—	—	—	—	—	—	—	—	—	—	—
13	*G. disperma* Rottl.	r	—	—	—	—	—	r	—	—	—	r	—	r	—	—	—	—
14	*G. emarginata* W. & A.	c	—	—	—	—	—	r	—	—	—	r	—	r	—	—	—	—
15	*G. microcos* L.	r	—	—	—	—	—	r	—	—	—	—	—	r	—	—	—	—
16	*G. obtusa* Wall.	r	—	—	—	—	—	r	—	—	—	—	—	—	—	—	—	—
17	*G. pilosa* Lam.	c	—	—	—	—	—	—	—	—	—	—	—	o	—	—	—	—
18	*G. salvifolia* Heyne	c	—	—	—	—	—	c	—	—	—	r	—	r	—	—	—	—
19	*G. lenax*(Forsk.) Fiori	c	—	—	—	—	—	r	—	—	—	r	—	o	—	—	—	—
20	*G. villosa* Willd.	o	—	—	—	—	—	c	—	—	—	r	—	r	—	—	—	—
21	*Muntingia calabura* L.	o	—	—	—	—	—	r	—	—	—	—	—	r	—	—	—	—
22	*Triumfetta annua* L.	o	—	—	—	o	—	—	—	—	—	—	—	—	—	—	—	—
23	*T. pentandra* Guill.	c	—	—	—	r	—	c	—	—	—	r	—	r	—	—	—	—
24	*T. pilosa* Lam.	o	—	—	—	c	—	r	c	—	—	r	—	r	—	—	—	—
25	*T. rhomboidea* Jacq.	r	—	—	—	—	—	—	—	—	—	r	—	r	—	—	—	—
26	*T. rotundifolia* Lam.	c	—	—	—	—	—	c	—	—	—	c	—	c	—	—	—	—
27	*Tricuspidaria dependens* Ruiz & Rav.	c	—	—	—	—	—	r	—	—	—	—	—	—	—	—	—	—

RESULTS

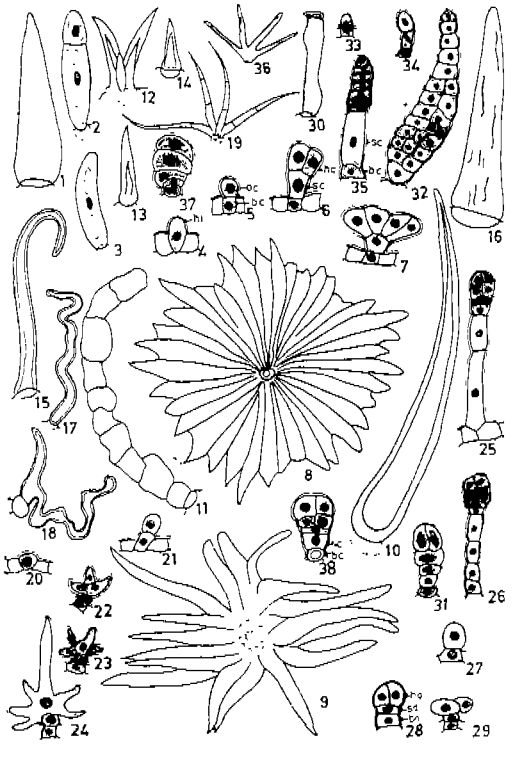
Structure and Ontogeny. The glandular and eglandular trichomes observed in this study originated from a single hair initial. The hair or trichome initial could be easily distinguished from the other epidermal cells by its papillate nature, larger size, prominent nucleus and denser cytoplasm. The trichome initial may or may not undergo further divisions to give rise to different types of eglandular and glandular trichomes. The ontogeny and structure of different types of trichomes are as follows:

I. Eglandular trichomes

1) Unicellular. The trichome initial increase in size, does not divide, elongates more and more and becomes highly vacuolated so that ultimately the trichome gets depleted of the cytoplasm and nucleus as a result of their degeneration. The outer walls of the trichomes are either straight, concave or convex; thin or thick with smooth or verrucose surface, thinly or thickly cutinized and narrow to broad lumen. The unicellular trichomes may be:(i) Simple (Fig. 17); (ii) Hooked (Fig. 15); (iii) Conical (Figs. 1, 10, 14 and 16) and (iv) Papillate (Fig. 13).

2) Multicellular. The trichome initial undergoes divisions as a result of which different types of multicellular trichomes are formed as follows:

v) Peltate scale: The hair initial divides periclinally to give rise to a basal cell and an outer cell (Figs. 4 and 5). The basal cell forms a simple foot without undergoing



Figs. 1~38. Various trichome types observed in the selected taxa of the Malvales.
1: Unicellular-conical(*Guazuma tomentosa*), 2 and 3: Development of simple uniseriate filiform(*Kleinhovia hospita*), 4~8: multicellular peltate scale(*Thespesia populnea*), 9: stellate with unicellular arms(*Malachra capitata*), 10: unicellular conical(*Hibiscus trionum*), 11: multicellular uniseriate filiform(*Hibiscus trionum*), 12: tufted(*Hibiscus schizopetalus*), 13: unicellular papillate (*Hibiscus schizopetalus*), 14: unicellular conical(*Hibiscus schizopetalus*), 15: unicellular hooked(*Hibiscus micranthus*), 16: unicellular conical(*Hbiscus micranthus*), 17: unicellular simple(*Hibiscus subdariffa*), 18: stellate with unicellular arms(*H. subdariffa*), 19: stellate with multicellular arms (*Melochia corchorifolia*), 20~24: development of stellate with unicellular or multicellular arms(*Malachra capitata*), 25: uniseriate stalk with fusiform head(*Melochia corchorifolia*), 26: uniseriate stalk with capitate head(*Melochia corchorifolia*), 27 and 28: Development of multicellular trichome(*Sida cordata*), 29: capitate multicellular trichome with unicellular stalk(*Sida cordata*), 31: unicellular stalk with a club-shaped multicellular head(*Sida triloba*), 32: biseriate stalk with fusiform multicellular head(*Abelmoschus manihot*), 33 and 34: Development of glandular multicellular trichome(*Malachra capitata*), 35: multicellular trichome with unicellular stalk(*Malachra capitata*), 36: Stellate with unicellular arms(*Hibiscus rosa-sinensis*), 37: unicellular stalk with a multicellular head(*Sida rhombifolia*), 38: Unicellular stalk with a capitate multicellular glandular head(*Sida rhombifolia*).
bc: basal cell; hc: head cell; hi: hair initial; sc: stalk cell. (Figs. 1~38, ×110)

divisions (Fig. 6). The outer cell becomes shield-shaped and divides anticlinally to form a multicellular non-glandular peltate head (Figs. 7 and 8).

vi) Simple uniseriate filiform: The papillate hair initial divides periclinally to form a basal cell and an outer cell (Figs. 2 and 3). The basal cell forms a simple foot. The outer cell undergoes successive periclinal division to form a multicellular uniseriate filiform body of the trichome. The lateral walls are thin or thick, straight, slightly convex or concave and thinly cutinized (Fig. 11). The cross walls are straight, thin or slightly thick. The surface of the trichome is smooth.

vii) and viii) Stellate with unicellular or multicellular arms (Figs. 9, 18, 19 and 36): The hair initial undergoes periclinal division to give rise to a basal cell and an outer cell (Figs. 20 and 21). The basal cell forms simple foot. The outer cell divides periclinally to form a stalk and a head cell (Fig. 22). The head cell proliferates to give rise to two to many arms in a stellate fashion (Figs. 22~24). The stalk cell forms an unicellular stalk. The arm may remain unicellular or become multicellular by undergoing periclinal divisions(Figs. 9, 18 and 36). The outer walls are straight or curved. Trichomes are covered by a thin layer of cuticle.

ix) Tufted: These trichomes arise from a group of hair initials. A tuft consists of two to many trichomes (Fig. 12).

Ⅱ. Glandular trichomes

3) Unicellular. x) Cylindrical (Fig. 30): These trichomes also orignate from a single hair initial by increasing in size. The body of the trichome is cylindrical. These are glutinous trichomes observed only in *Sida glutinosa* of the Malvaceae.

4) Multicellular. The trichome initial divides periclinally to give rise to a basal cell (bc) and an outer cell (oc) (Figs. 27 and 33). The basal cell (bc) forms a simple foot. The outer cell (oc) divides periclinally to form a stalk (sc) and a head cell (hc) (Figs. 28 and 34). The further classification of these trichomes is based upon the division/s in the stalk and head cell. The stalk remains either unicellular or becomes multicellular as a result of divisions. The head cell may divide to form either an uniseriate, capitate, fusiform or clavate glandular head containing granular substance. A thin layer of cuticle runs over the trichomes. The outer walls are either straight, concave or convex.

A) Unicellular stalk

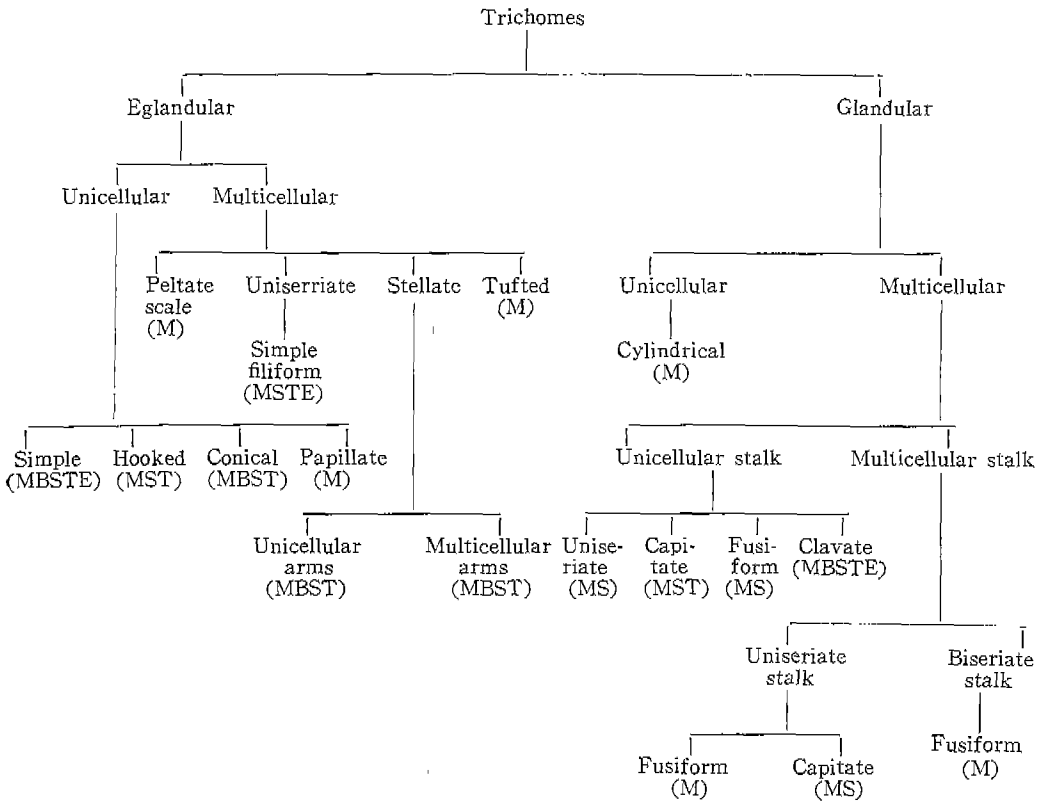
xi) Uniseriate (Fig. 37): The trichome is differentiated into a simple foot, unicellular stalk and an uniseriate glandular-granular multicellular head.

xii) Capitate (Figs. 29 and 38): The trichome is differentiated into a simple foot, unicellular stalk and a capitate multicellular, glandular-granular head.

xiii) Fusiform (Fig. 35): The trichome is differentiated into a simple foot, unicellular stalk and a fusiform multicellular, glandular-granular head.

xiv) Clavate (Fig. 31): The trichome is differentiated into a simple foot,

Chart 1. Classification of various trichome types in the selected families of Malvales.
M: Malvaceae, B: Bombacaceae, S: Sterculiaceae, T: Tiliaceae, and E: Elaeocarpaceae.



unicellular stalk and a club-shaped, multicellular glandular-granular head.

B) Multicellular stalk

a) Uniseriate stalk: The stalk cell undergoes periclinal divisions to form an uniseriate multicellular stalk.

xv) Fusiform (Fig. 25): The trichomes are differentiated into a simple foot, uniseriate stalk and a fusiform multicellular, glandular-granular head.

xvi) Capitate (Fig. 26): The trichomes consist of simple foot, uniseriate stalk and a capitate multicellular head containing glandular-granular substance.

b) Biseriate stalk: The stalk divides anticlinally and then periclinally to form a biseriate stalk.

xvii) Fusiform (Fig. 32): These bizzare glandular trichomes consisting of a simple foot, biseriate stalk and fusiform multicellular head.

Classification. Eglandular and glandular trichomes of 17 types have been observed in the members of the order Malvales. The trichomes are classified on the basis of form, structure and contents (Chart 1).

DISCUSSION

Metcalfe and Chalk (1950) recorded 10 glandular and eglandular types of trichomes in the families of Malvales. Inamdar and Chohan (1969 a,b) listed 6 trichome types in the 18 species of the Malvaceae and Bombacaceae. Ramayya and Rao (1976) studied the morphology, phylesis and biology of the peltate scale, stellate and tufted hairs in 3 species of the Malvaceae. Rao and Ramayya (1977) reported 16 trichome types in the Indian species of *Malvastrum*. Here in this study of 39 genera and 125 species of the selected families in the Malvales, 9 types of eglandular and 8 glandular trichomes have been observed. The classification of trichomes is based on their form, structure and contents. Both the eglandular and glandular trichomes are divided into unicellular and multicellular which are further sub-divided into 17 types (Chart 1). The species-wise frequency of the trichome types was compiled in Table 1.

Solereder (1908), Metcalfe and Chalk (1950), Uphof (1962), Inamdar (1967), Patel and Inamdar (1972), Inamdar and Patel (1973), Ramayya and Rao (1976), Gangadhara and Inamdar (1977) and Rao and Ramayya (1977) emphasized the taxonomic significance of trichomes. It is evident from the comparison of trichome types in different families of Malvales that about 8 types are common among families Malvaceae, Sterculiaceae, and Tiliaceae (Chart 1). Bombacaceae manifest only 5 and Elaeocarpaceae only one trichome type/s. Therefore, the separation of families Bombacaceae and Elaeocarpaceae seems to be justified.

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