

# Crystalliferous cells in leaf epidermis of Malvales in relation to Taxonomy

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Morphology and distribution of crystalliferous cells occurring in leaf epidermis of Malvales are studied. Thirty five out of 50 species studied were found to possess crystalliferous cells. The leaves are described as amphi-, hypo- and epicrystalliferous. Based on the distribution of the crystalliferous cells on a given surface of the leaf, seven crystalliferous cell distributional patterns are described.

**Key-words-** Malvales, Leaf epidermis, Taxonomy.

## INTRODUCTION

IDIOBLASTIC cells (cells containing crystals, mucilage tannins, gum, resin etc.) are one of the important components of epidermis in some taxa and are considered as taxonomically significant (Solereider 1908; Metcalfe & Chalk 1950, 1983; Horner & Whitmoyer 1972; Horner & Wagner 1980; Prabhakar & Ramayya 1980; Leelavathi *et al.* 1984; Prabhakar *et al.* 1988; Gregory & Bass 1989). However, information on these cells in angiospermous epidermis in general and Malvales in particular is meagre (Solereider 1908; Metcalfe & Chalk 1950; Al-Rais *et al.* 1971). Though several workers described the epidermis of Malvales (Inamdar & Chohan 1969a, 1969b; Kidwai, 1979; Rao & Ramayya, 1982, 1983a, b, 1984), very little attention has been paid on the structure, occurrence and distributional patterns of crystalliferous cells in epidermis.

## MATERIAL AND METHODS

Mature leaves of 50 species of Malvales collected from different places of India were fixed in Carnoy's fixative (Johansen, 1940). Ten epidermal peels of leaves collected from five plants of each species were prepared from base to apex and midvein to margins following the procedure of Leelavathi and Ramayya (1975). Microtome sections of the leaves were made following the usual paraffin method (Johansen, 1940).

## OBSERVATIONS AND DISCUSSION

Earlier, sphaero-crystals of calcium oxalate were recorded in the epidermis of *Gossypium arboreum*, *G. hirsutum* (Inamdar & Chohan, 1969a, 1969b), *Pterospermum acerifolium* and *Sterculia foetida* (Rao & Ramayya, 1984). In this study 35 species showed the crystalliferous cells in the epidermis (Table 1), and the remaining 15 species [*Abutilon crispum*, *Althaea rosea*, *Eriodendron pentandrum*, *Gossypium arboreum*, *G. herbaceum*, *Hibiscus sabdariffa*, *H. vitifolius*, *Thespesia lampas*, *Sida cordifolia*, *S. rhombifolia* (Malvaceae); *Buettneria herbacea*, *Melochia corchorifolia*, *Melhania incana*, *Waltheria indica* (Sterculiaceae), *Triumfetta pentandra* (Tiliaceae) did not show]. The localisation of the crystals in epidermis has also been confirmed in the sectional view of the leaves.

Sixteen species showed only sphaero-crystals and 10 only prismatic crystals (triangular, rectangular, rhomboidal, squarish and fusiform) and the remaining nine showed both sphaero- and prismatic crystals. The leaves are described as amphicrystalliferous (crystalliferous cells present both in adaxial and abaxial epidermis), epicrystalliferous or hypocrystalliferous (crystalliferous cells either present in adaxial/abaxial epidermis). Almost all the species showed either amphi- or epicrystalliferous condition (Table 1) and hypocrystalliferous condition is encountered only in *Muntingia calabura* (Table 1).

Table 1: Distribution of calcium oxalate crystals in leaf epidermis of Malvales

Name of the species	Intercostal zone			Costal zone			Type of leaf	
	EPI Ad/Ab	TB Ad/ab	GC	SUB Ad/Ab	MV Ad/Ab	SV Ad/Ab		TV Ad/Ab
<b>MALVACEAE</b>								
1. <i>Abelmoschus ficulneus</i>	S/-	-	-	-	-	-	-	EP
2. <i>Abutilon glaucum</i>	S/-	-	-	-	S/-	-	-	EP
3. <i>Adansonia digitata</i>	S/-	-	-	-	S/-	-	-	EP
4. <i>Bombax malabaricum</i>	S/S	S/S	S	S/S	S/S	S/S	S/S	AM
5. <i>Hibiscus cannabinus</i>	S/S	-	-	S/S	S/S	-	-	AM
6. <i>H. lobatus</i>	P/S	-	-	-	-	-	-	AM
7. <i>H. micranthus</i>	SP/-	-	-	-	-	-	-	EP
8. <i>H. rosasinensis</i>	SP/-	-	-	-	-	-	-	EP
9. <i>H. tilliaceus</i>	S/-	-	-	-	-	-	-	EP
10. <i>Malvastrum coramandelianum</i>	S/S	-	-	S/S	S/S	S/S	S/S	AM
11. <i>Malva discolor</i>	P/-	-	-	-	-	-	-	EP
12. <i>Pavonia odorata</i>	P/-	-	-	-	-	-	-	EP
13. <i>P. zeylanica</i>	P/-	-	-	-	-	-	-	EP
14. <i>Thespesia populnea</i>	S/-	-	-	-	-	-	-	EP
15. <i>Sida acuta</i>	S/S	-	S	-	-	-	-	AM
16. <i>S. cordata</i>	S/S	-	S	-	-	-	-	AM
17. <i>S. glutinosa</i>	S/S	-	S	-	-	-	-	AM
18. <i>S. spinosa</i>	S/-	-	-	-	-	-	-	EP
<b>STERCULIACEAE</b>								
19. <i>Dombeya cayeuxii</i>	P/-	-	-	-/P	P/P	P/P	-	AM
20. <i>Guazuma tomentosa</i>	S/-	-	-	-	-	-	-	EP
21. <i>Helicteres isora</i>	P/-	-	-	-	-	-	-	EP
22. <i>Kleinhovia hospita</i>	-	-	-	-	P/P	P/P	-	AM
23. <i>Pterospermum acerifolium</i>	SP/SP	SP/SP	S	SP/SP	SP/SP	SP/SP	SP/SP	AM
24. <i>Sterculia foetida</i>	S/S	S/S	S	S/S	S/S	S/S	SP/SP	AM
<b>TILIACEAE</b>								
25. <i>Corchorus acutangulus</i>	SP/-	-	-	-	-	-	-	EP
26. <i>C. fascicularis</i>	S/-	-	-	-	-	-	-	EP
27. <i>C. olitorius</i>	SP/-	-	-	-	-	-	-	EP
28. <i>C. tridens</i>	SP/-	-	-	-	-	-	-	EP
29. <i>C. trilocularis</i>	SP/-	-	-	-	-	-	-	EP
30. <i>C. urticaefolius</i>	SP/-	-	-	-	-	-	-	EP
31. <i>Grewia flavescens</i>	-	-	-	-	-	P/P	-	AM
32. <i>G. hirsuta</i>	-	-	-	-	-	P/P	P/P	AM
33. <i>G. tilliaefolia</i>	-	-	-	-	-	P/P	-	AM
34. <i>Muntingia calabura</i>	-	-/P	-	-	-	-	-	HP
35. <i>Triumfetta rhomboidea</i>	S/S	-	-	S/S	S/S	S/S	-	AM

Ab = abaxial; Ad = adaxial; AM = amphotalliferous; EP = epicrystalliferous; EPI = epidermis; GC = guard cell; HP = hypocrystalliferous; MV = midvein; P = prismatic crystal; S = sphaero-crystals; SP = prismatic and sphaero-crystals; SV = secondary vein; SUB = subsidiaries; TB = trichome basal cell; TV = tertiary vein.

## PLATE 1

(All photographs x 145)

Figures 1-11. Epidermis showing crystalliferous idioblastic cells in intercostal areas.

1. *Adansonia digitata* adaxial epidermis.
2. *Bombax malabaricum* adaxial epidermis.
3. *Triumfetta rhomboidea* adaxial epidermis.
4. *Muntingia calabura* abaxial epidermis (crystal in trichome base).
5. *Helicteres isora* adaxial epidermis.
6. *Sterculia foetida* abaxial and 9-11. adaxial epidermis.
- 7-8. *Pterospermum acerifolium* adaxial and abaxial epidermis respectively.

tively.

Figures 12-24. Epidermis showing crystalliferous idioblastic cells in costal areas.

- 12-15. *Bombax malabaricum* adaxial epidermis.
  16. *Pterospermum acerifolium* adaxial epidermis.
  - 17-21. *Sterculia foetida* adaxial epidermis.
  - 22-23. *Dombeya cayeuxii* adaxial and 24. abaxial epidermis.
- (m = Mucilaginous cells; p = Prismatic crystal; s = Sphaero-crystal.

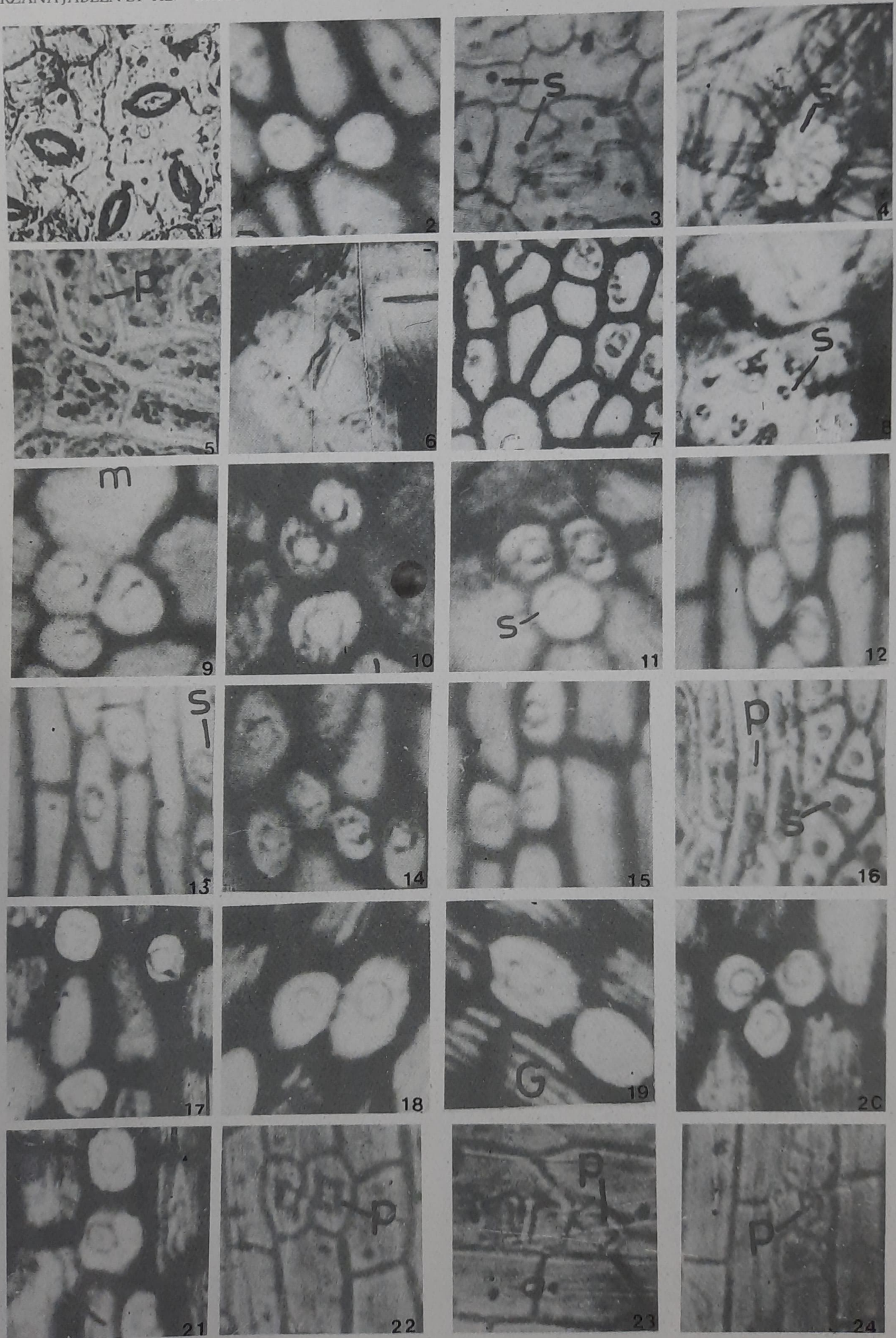


PLATE 1

The crystalliferous cells are similar to the epidermal cells in shape, size and anticlinal walls, except in *Bombax malabaricum*, *Hibiscus rosa-sinensis*, *Malva viscus arboreus*, *Pavonia odorata*, *P. zeylanica*, *Dombeya cayeuxii*, *Helicteres isora*, *Kleinhovia hospita*, *Sterculia foetida*, *Grewia flavescens*, *G. hirsuta*, *G. tiliifolia* and *Muntingia calabura* (Pl.1, figs. 2, 9, 22), where they are smaller and circular to polygonal. The crystalliferous cells are solitary intermixed with other epidermal cells in majority of the species, while in others they are in pairs (Pl.1, fig. 22), clusters of 3-8 cells (Pl.1, fig. 14) or in transverse or vertical rows of 3-12 cells.

The distribution of these crystalliferous cells varies not only from species to species and from one surface of the lamina to the other, but also from one region to the other on a given surface of the leaf lamina. The crystalliferous cells may be confined to costal areas as in *Kleinhovia hospita*, *Grewia flavescens*, *G. hirsuta* and *G. tiliifolia* or to intercostal areas as in *Abelmoschus* and most of the other taxa or they may be present in intercostal as well as costal areas as in *Adansonia* and other 8 taxa (see Table 1). Further in some taxa besides the general epidermal and costal cells, the crystals may be present in the subsidiary cells as in *Hibiscus cannabinus*, *Malvastrum coramandelianum*, *Dombeya cayeuxii* and *Triumfetta rhomboidea*; guard cells as in *Sida acuta*, *S. cordata* and *S. glutinosa*; trichome base, subsidiary and guard cells as in *Bombax malabaricum*, *Pterospermum acerifolium* and *Sterculia foetida* or only trichome base in *Muntingia calabura* which is of further taxonomic significance. On the basis of a comparative study of the distribution of crystalliferous cells, seven discrete patterns have been recorded.

**Pattern 1.** Crystals present in intercostal epidermal cells, costal cells, subsidiary cells, guard cells and trichome base as in leaf adaxial and abaxial epidermis of *Bombax malabaricum*, *Pterospermum acerifolium* and *Sterculia foetida* (Pl.1, figs 2, 6-21; Table 1).

**Pattern 2.** Crystals distributed as above except in guard cells and trichome base as in leaf adaxial and abaxial epidermis of *Malvastrum cormandelianum*, *Dombeya cayeuxii*, *Hibiscus cannabinus* and *Triumfetta rhomboidea* (Pl.1, figs 3, 22-24; Table 1).

**Pattern 3.** Crystals present only in intercostal epidermal and costal cells as in adaxial epidermis of *Abutilon glaucum* and *Adansonia digitata* (Pl.1, fig. 1; Table 1).

**Pattern 4.** Crystals present in intercostal epidermal cells and guard cells eg. *Sida acuta*, *S. cordata* and *S. glutinosa* (Table 1).

**Pattern 5.** Crystals restricted to intercostal epidermal cells as in adaxial and abaxial epidermis of *Helicteres isora* and other 17 taxa (Pl.1, fig.5; Table 1).

**Pattern 6.** Crystals present only in costal cells as in adaxial and abaxial of *Kleinhovia hospita*, *Grewia flavescens*, *G. hirsuta* and *G. tiliifolia* (Table 1).

**Pattern 7.** Crystals present only in basal cells of the trichome as in adaxial epidermis of *Muntingia calabura* (Pl.1, fig. 4; Table 1).

*Abutilon*, *Adansonia*, *Bombax*, *Malvastrum*, *Guazuma* and *Sterculia* are characterised by only sphaero-crystals, while *Malva viscus*, *Pavonia*, *Dombeya*, *Helicteres*, *Kleinhovia*, *Grewia* and *Muntingia* contain only prismatic crystals. *Pterospermum* and *Corchorus* (except *C. fascicularis*) contain both sphaero-and prismatic crystals (Table 1). Further some of the species in *Hibiscus*, *Thespesia*, *Sida*, *Triumfetta* show sphaero-crystals or both sphaero-and prismatic crystals while others do not show any crystals. The characters of the crystalliferous cells in conjunction with mucilaginous cells and other epidermal cells could be more taxonomically significant.

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