STUDIES ON LEAF EPIDERMIS AND STOMATA IN THE GENUS *GLORIOSA* L.

B. A. HEGDE & M. R. LUGADE

Department of Botany, Shivaji University, Kolhapur 416 004, India

Abstract

The tendrillar hypostomatic leaves with anomocytic stomata without subsidiary cells is the stable character of *Gloriosa* L. However, epidermal patterns including shape and size of cells, stomatal dimensions, frequency/mm² and stomatal index, etc. provide characters which help in the identification of the five species and three naturally occurring hybrids of *Gloriosa* L. investigated by the authors.

Introduction

The present study deals with leaf epidermis of five species and three naturally occurring hybrids of *Gloriosa* L. covering the morphology, distribution and disposition of their stomata and size and also the wall pattern of epidermal cells which could serve as additional aids in the identification of the species of the genus in conjunction with their other characters.

Epidermal peels in the middle portions of both the surfaces of mature leaves of five species and three naturally occurring hybrids of *Gloriosa*: *G. superba* L., *G. lutea* Hort., *G. plantii* Loud., *G. lemon-drops* (natural hybrid), *G. masterpiece* (natural hybrid), *G. carsonii* Baker, *G. rothschildiana* O'Brien and *G. shrimati-bhima* (natural hybrid) were taken by hand, stained with one per cent propionocarmine and mounted in saturated aqueous solution of polyvinylpyrrollidone (Burstone, 1957). Stomata per unit area on the peelings of both the epidermis of each of the species and the hybrid were scored. The shape and size of epidermal cells and stomata of each of the species and the hybrid were measured under high magnifications (5x×45x). Stomatal index was calculated following the method of Cutter (1969).

Description

Epidermal patterns of the genus *Gloriosa* L. (Plates 1, 2; Table 1) exhibit wavy, rectangular or almost straight and sinuate cell wall with following distinguishing key characters :

A. *Epidermal cells with wavy walls*

1. Epidermal cells small (71.75-84.6× 40.73-26.78μm) with undulated wall, stomatal frequency highest (132.5), stomata small (38.29× 29.21μm) with high stomatal index (32.62). . . *G. superba* L.

2. Large epidermal cells (84-101.82× 31.31-58.55 μm) with highly wavy walls, stomatal frequency high (86.4), stomata small (39.99×28.92 μm) with lower stomatal index (26.09) . . . *G. lutea* Hort.

3. Larger epidermal cells (126.6-143.02×32-68.18 μm) with low stomatal frequency (76), stomata larger (48.51×35.95 μm) with lower stomatal index (25.16) . . . *G. plantii* Loud.

B. *Rectangular or almost straight epidermal cell walls*

1. Small rectangular epidermal cells (74.19-79.83×18.95-22.37 μm) with low stomatal frequency (65.16), stomata larger (41.95×33.1 μm) with lower stomatal index (28.9) . . . *G. lemon-drops* (natural hybrid).

2. Large epidermal cells (94.19-114.32 ×64.52-83.87 μm) having almost straight walls with lower stomatal frequency (41.6), larger stomata (53.19×42.18 μm) with

Table 1—Showing epidermal and stomatal patterns of *Gloriosa* L.

Taxa	Size of epidermal cells in μm*		Epidermal cell wall structure	Stomatal frequency/ mm²	Size of stomata in μm*		Stomatal Index*
	Length	Breadth			Length	Breadth	
G. superba L.	71.75-84.6	40.73-26.78	Wavy	132.5 ±6.35	38.29 ±0.58	29.21 ±0.5	32.62
G. lutea Hort.	84.00-101.82	31.31-58.55	Wavy	86.4 ±5.73	39.99 ±0.68	28.92 ±0.46	26.09
G. plantii Loud.	126.6-143.02	32.00-68.18	Wavy	76.00 ±5.46	48.51 ±0.55	35.95 ±0.41	25.16
G. lemon-drops (natural hybrid)	74.19-79.83	18.95-22.37	Rectangular	65.16 ±3.83	41.95 ±0.43	33.1 ±0.35	28.9
G. carsonii Baker	94.19-114.32	64.52-83.87	Almost straight	41.6 ±3.24	53.19 ±0.72	42.18 ±0.56	34.97
G. masterpiece (natural hybrid)	112.00-138.09	17.23-66.71	Sinuate	89.4 ±9.21	39.41 ±0.58	30.41 ±0.32	36.12
G. rothschilaiana O'Brien	130.32-149.94	51.61-99.1	Sinuate	43.6 ±1.2	52.2 ±0.62	39.01 ±1,01	39.53
G. shrimati-bhima (natural hybrid)	102-124.55	54.89-82.46	Sinuate	53.3 ±2.23	56.17 ±0.52	40.2 ±0.36	38.28

*Mean of 25 readings; ±=S. E.

higher stomatal index (34.97) . . . *G. carsonii* Baker.

C. *Epidermal cells with sinuate walls*

1. Walls distinctly curved forming 'U' shaped sinuses, epidermal cells larger (112-138.39 × 17.23-66.71 μm) with high stomatal frequency (89.4), stomata small (39.41 × 30.41 μm) with higher stomatal index (36.12) . . . *G. masterpiece* (natural hybrid).

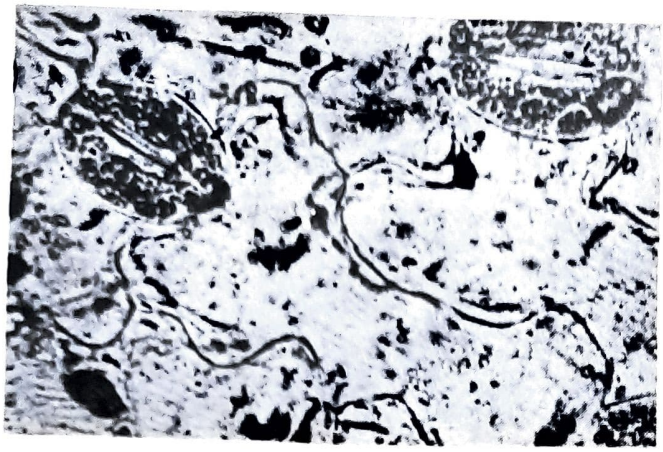
2. Epidermal cells largest (130.32-149.94 × 51.61-99.1 μm) with lower stomatal frequency (43.6), stomata larger (52.2 × 39.1 μm) with very high stomatal index (39.53) . . . *G. rothschildiana* O' Brien.

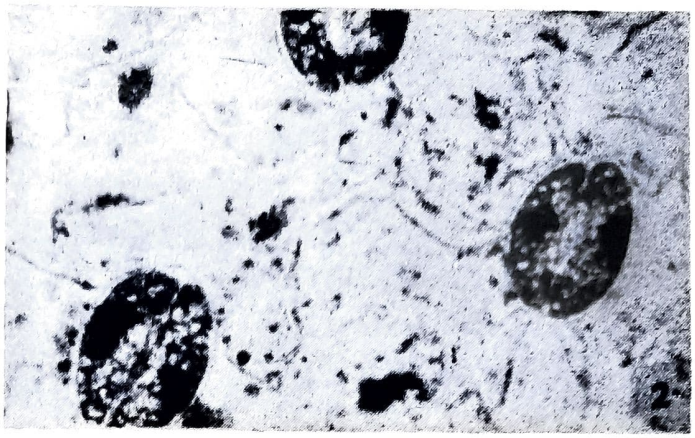
3. Larger epidermal cells (102-124.55 × 54.89-82.46 μm) with low stomatal frequency (53.3), stomata very large (56.17 × 40.2 μm) with higher stomatal index (38.28) . . . *G. shrimati-bhima* (natural hybrid).

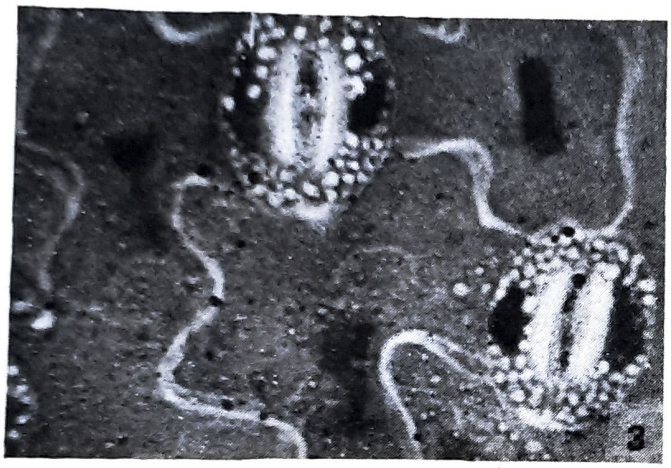
Discussion

The tendrillar leaves of five species and three naturally occurring hybrids of *Gloriosa* L. are hypostomatic and the guard cells lack subsidiary cells. Therefore, it falls into the category of anomocytic type of Metcalfe and Chalk (1950) and of category IV of Stebbins and Khush (1961) possessing two guard cells without subsidiary cells which is characteristic feature of the Liliales.

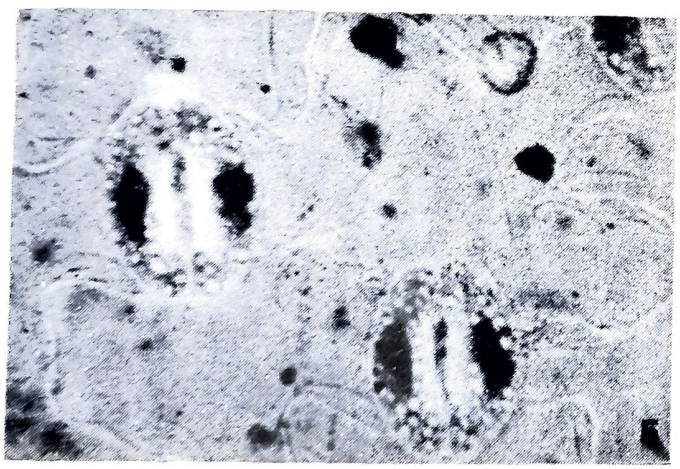
Regarding the size and the dimensions of epidermal cells there seems to be no correlation with ploidy levels, although most diploids, *G. superba* L. and *G. lutea* Hort. exhibit smaller epidermal cells. *G. plantii* Loud. which is also a diploid has larger epidermal cells ranging from 127-143 × 32-68 μm. This dimension is quite comparable to that of an octaploid *G. rothschildiana* O'Brien which exhibit the epidermal dimensions of 130-150 × 52-99 μm. Ironically *G. shrimati-bhima* (natural hybrid) which is also an octaploid has epidermal cell size 102-125 × 55-82 μm. Such heterogeneity in the size and dimensions of epidermal cells possibly correlates more with shape and size of the leaf rather than the ploidy. This explains the linear leaf epidermal patterns found in *G. lemon-drops* (natural hybrid). Similar to epidermal cells, there is no much seeming relation between ploidy and stomatal index. No doubt, octaploids *G. rothschildiana* O'Brien and *G. shrimati-bhima*

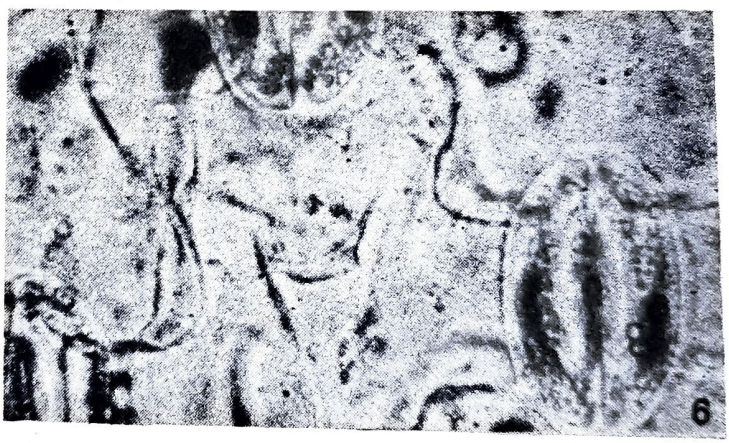


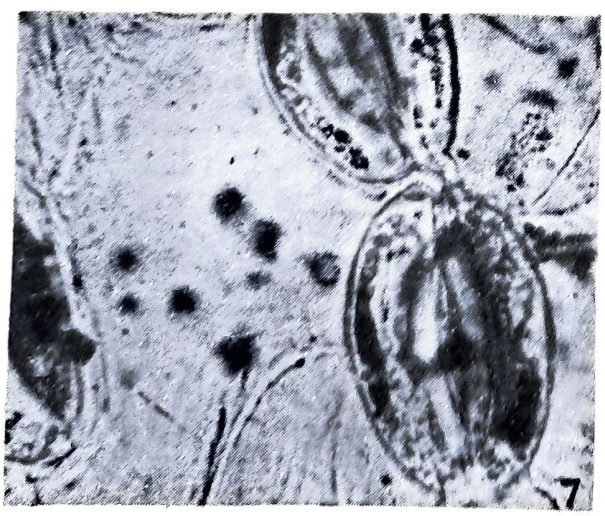

2

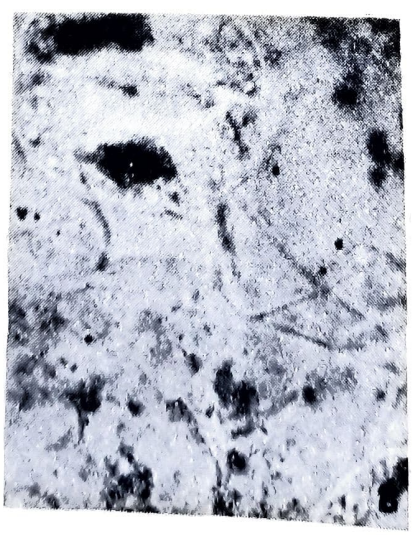

3

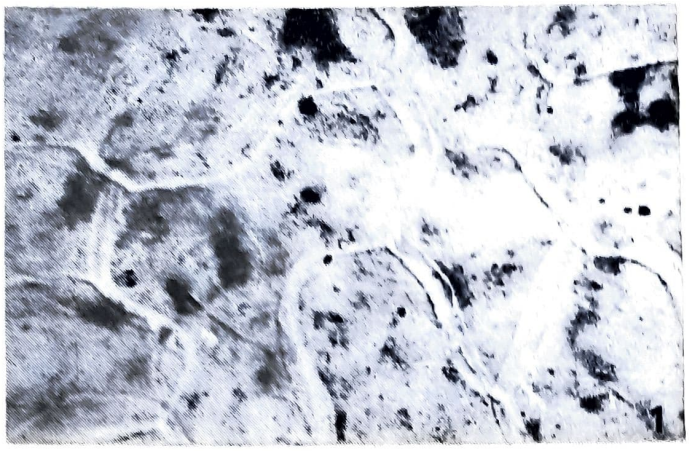

4

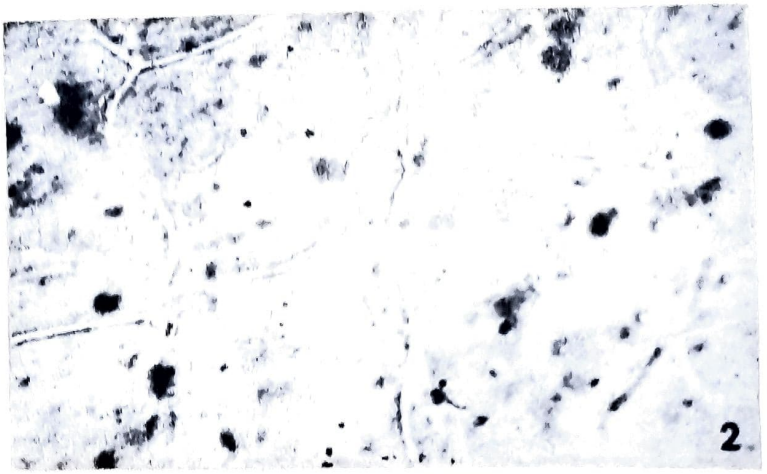

5

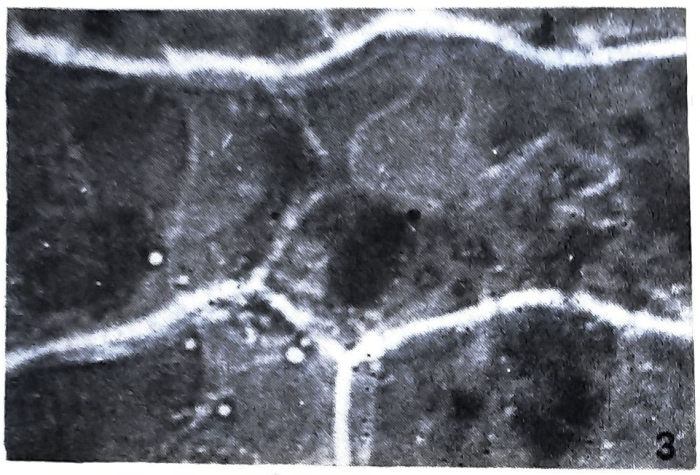

6

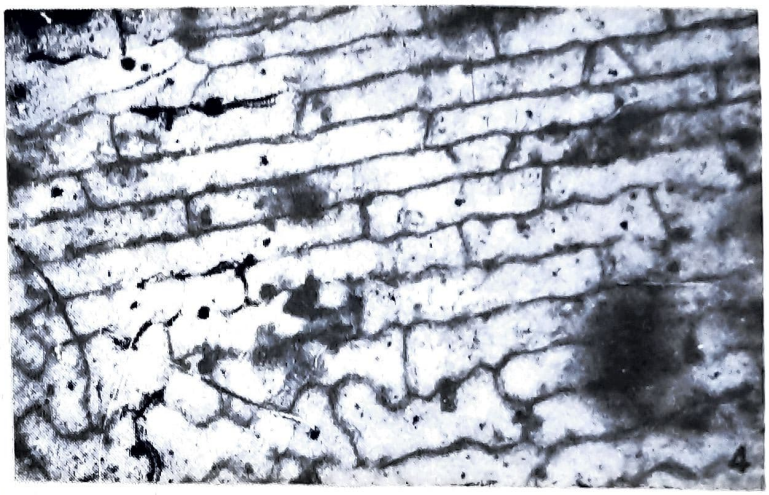

7

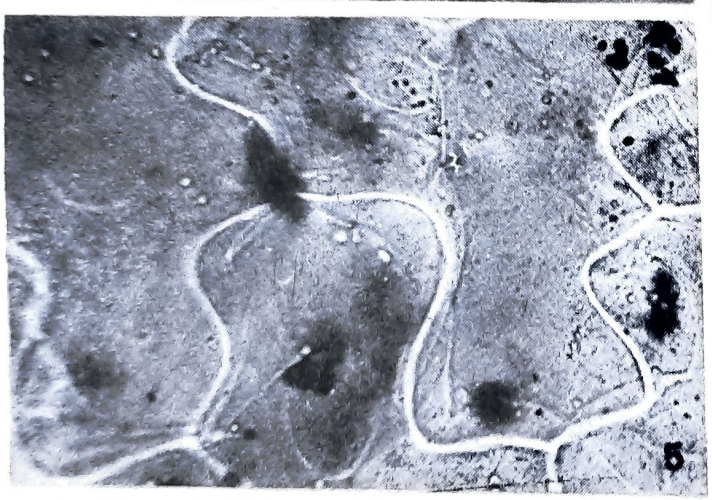

8

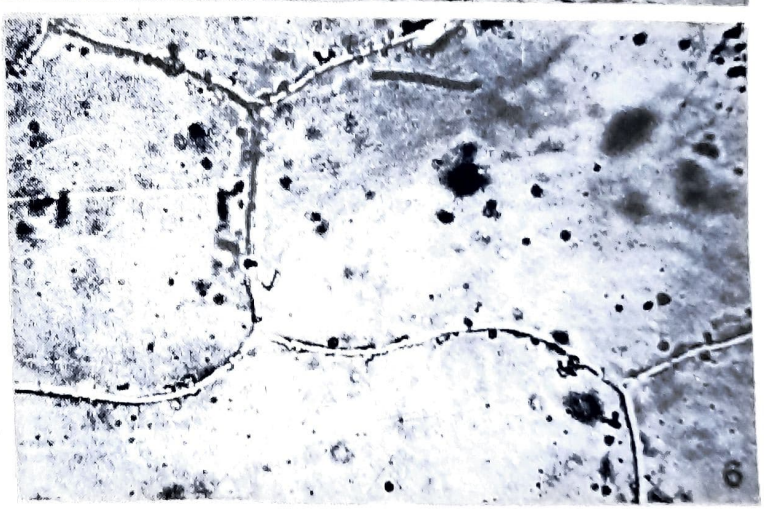

1

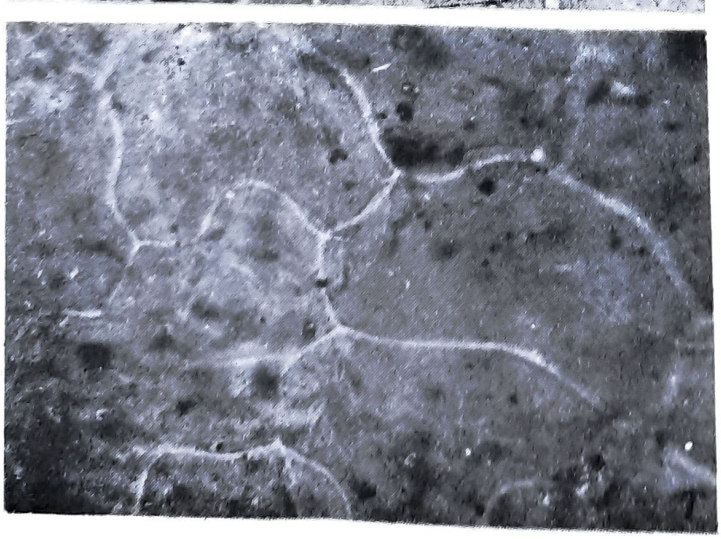

2

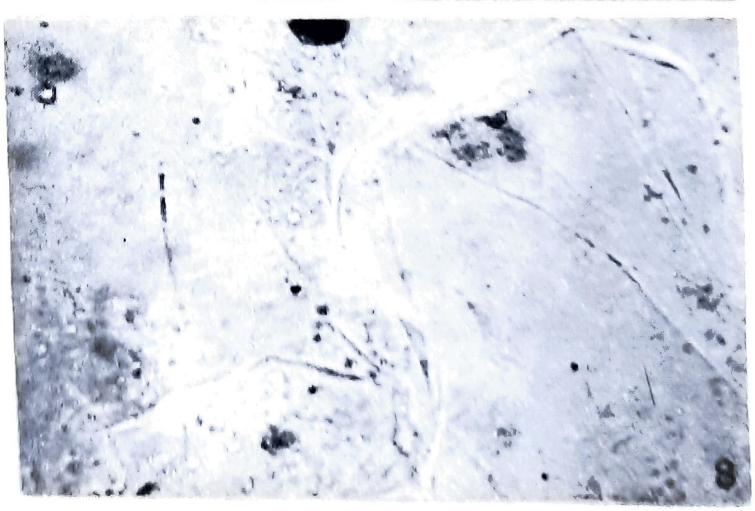

3


4


5


6


7


8

(natural hybrid) exhibit high stomatal indices, but the tetraploids *G. carsonii* Baker and *G. masterpiece* have relatively low stomatal indices. The diploids *G. superba* L. and *G. lutea* Hort. have moderately high stomatal indices. Striking peculiarity is in the octaploids *G. rothschildiana* O'Brien and *G. shrimati-bhima* (natural hybrid) were with high stomatal indices, the size of the stomata is also large. Among the tetraploids only *G. carsonii* Baker has large stomata but the stomatal index of tetraploids or *G. carsonii* Baker is relatively low. These observations point out that there is no correlation between ploidy level and stomatal index and size. The wide variations in the frequency of stomata, irrespective of their ploidy level and lack of seeming relationship of frequency with the size and the stomal index appears to be an exception to the normal tendency exhibited by the plants. Trivedi and Upadhyay (1984) made a comprehensive study of the epidermal cells, stomatal index and frequency in the family Asclepiadaceae and their study also revealed no seeming correlation with stomal size, frequency and index.

The common occurrence of anomocytic stomata appears to be a stable character of the genus *Gloriosa* L. Hypostomatic leaves with irregular and anisodiametric epidermal cells exhibit an advanced characters.

Acknowledgements

One of us (MRL) is thankful to the C. S. I. R., New Delhi for financial support.

References

Burston, M. S. (1957). Polyvinyl pyrrollidone as a mounting medium for fat stains and Azo-Dye procedures, pp. 625 *in* : *Selected histochemical and histopathological methods*, S. W. Thompson, Charles C. Thomas Publishers, Springfield Illinois, U.S.A.

Cutter. E. G. (1969). *Plant anatomy*. Part-I. Edward Arnold, London.

Metcalfe, C. R. & Chrlk, L. (1950). *Anatomy of dicotyledons*. **1** : Clarendon Press, Oxford.

Stebbins, G. L. & Khush, G. S. (1961). Variation in the organization of the stomatal complex in the leaf epidermis of monocotyledons and its bearing on their phylogeny. *Am. J. Bot.*, **48** : 51-69.

Trivedi, B. S. & Upadhyay, N. (1984). Cuticular studies of Asclepiadaceae. *J. Indian bot. Soc.*, **36** : 129-135.

Explanation of Plates

Plate 1

Portions of lower epidermis of *Gloriosa* L. leaves in surface view :

1. *G. superba*
2. *G. lutea*
3. *G. plantii*
4. *G. lemon-drops*
5. *G. masterpiece*
6. *G. carsonii*
7. Abnormal stomata (aborted as well as pole to pole contiguous stomata in *G. carsonii*
8. *G. rothschildiana*
9. *G. shrimati-bhima*

Plate 2

Portions of upper epidermis of *Gloriosa* L. leaves in surface view :

1. *G. superba*
2. *G. lutea*
3. *G. plantii*
4. *G. lemon-drops*
5. *G. masterpiece*
6. *G. carsonii*
7. *G. rothschialdiana*
8. *G. shrimati-bhima*