1. Kirtikar, K. R. and Basu, B. D., *Indian Medicinal Plants*, Vol. I. L. M. Basu, Allahabad, 1914.
2. Anonymous, *The Wealth of India*, II CSIR, New Delhi, 1950.
3. Bell, C. R. and Constance, L., *Amer. J. Bot.*, 1960, **47,** 24.
4. Mitsukuri, Y. and Kurahori, Y., *Kromosomo*, 1959, **40,** 1354.
5. Sharma, A. K. and Ghosh, C., *Genetica*, 1954, **27,** 17.
6. Sharma, A. K. and Bhattacharyya, N. K., *Genetica*, 1957, **30,** 1.
7. Sharma, A. K. and Raghuvansi, S. S., *Genetica Iberica*, 1957, **9,** 143.
8. Joshi, S. and Raghuvansi, S. S., *Genetica Iberica*, 1970, **22,** 161.
9. Mitra, K. and Datta, N., *Taxon*, 1967, **16,** 445.
10. Baquar, S. R., *Rev. Biol.*, 1967, **6,** 440.
11. Hsu, C. C., *Taiwania*, 1967, **13,** 117.
12. Datta, P. C. and Maiti, R. K., *Nucleus*, 1969, **11,** 111.
13. Hsu, C. C., *Taiwania*, 1968, **14,** 11.
14. Raghuvansi, S. S. and Joshi, S., *Nucleus Suppl. Vol.* 1968, **10,** 319.
15. Constance, L. Chung, T. I. and Bell, C. R., *Amer. J. Bot.*, 1971, **58,** 577.
16. Nagendra Prasad, P. and Janaki Ammal, E. K., *Indian J. Forestry*, 1984 (in press)

FOLIAR EPIDERMAL STUDIES IN AMARANTHACEAE

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THE epidermal studies and pattern of stomatal distribution play a key role in determining the phylogenetic position of the taxa as suggested by Metcalfe and Chalk[1], Stebbins[2], Stebbins and Khush[3]. Reports concerning epidermal studies in quite a good number of families are available but such information for the family Amaranthaceae is scanty. The present study is spread over three tribes of Amaranthaceae which include nine genera with thirteen species in all. The species investigated are *Celosia cristata* L and *C. argentea* L of Celosieae tribe; *Amaranthus blitum* var *oleracea* Hook f, *A. gracilis* Desf, *A. tricolor* L, *Digera alternifolia* Aschers, *Pupalia lappacea* Juss, *Aerva lanata* Juss, *A. tomentosa* Forsk, *Achyranthes aspera* Hook f and *Iresine lindenii* Van Houtte of Amarantae tribe; and *Gomphrena globosa* L, *Alternanthera pungens* H.B. & K. of Gomphreneae tribe.

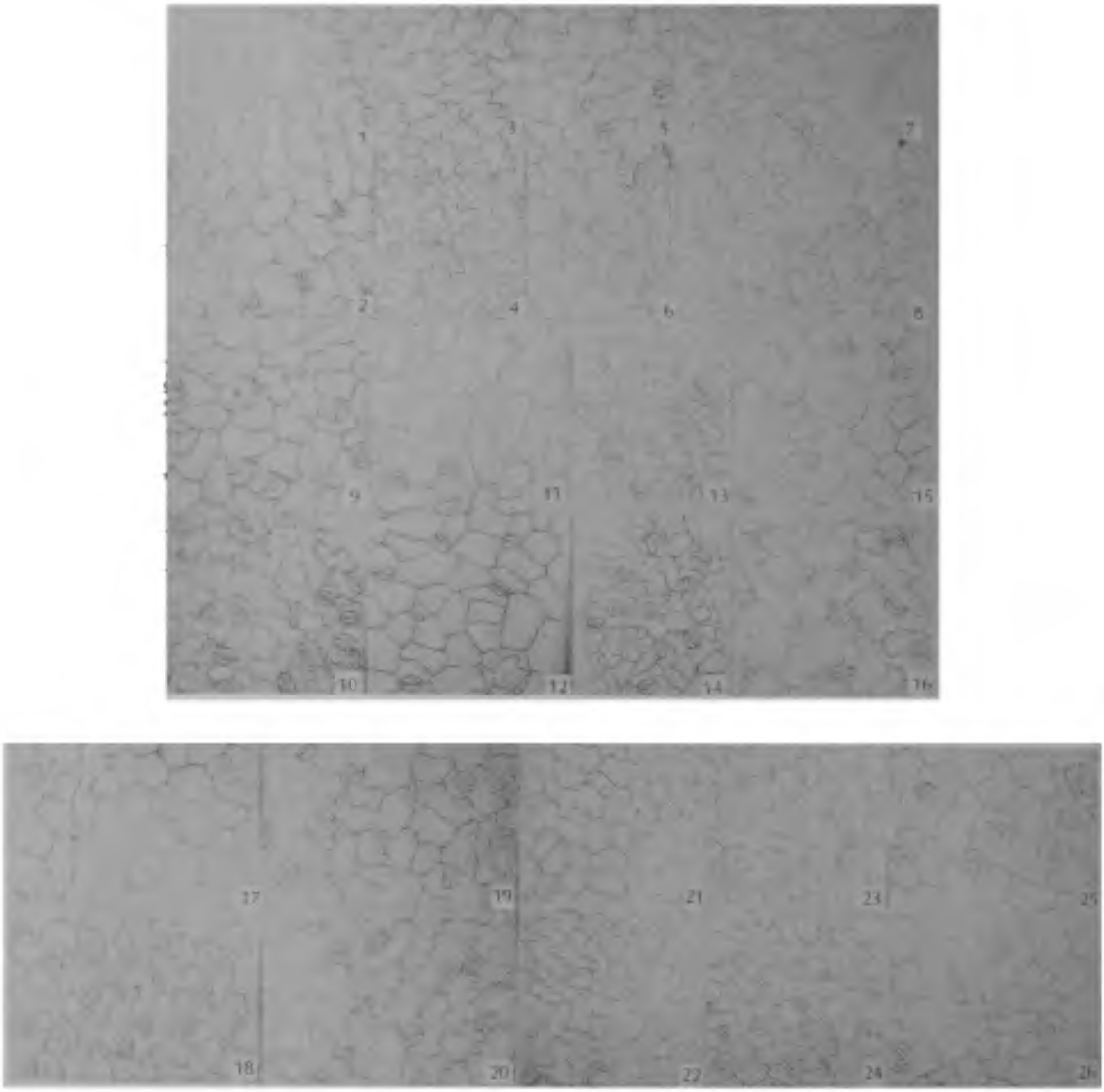
The method employed for the preparation of slides was same as Kaushik[4]. Stomatal and epidermal counts per unit area were made by the conventional method and the stomatal index was calculated using Salisbury[5] formula.

The leaves are amphistomatic in all the species investigated and fall under the anomocytic category except *Alternanthera pungens* (figures 25, 26) which show an inclination toward paracytic type. Anomocytic stomata are usually surrounded by 3–5 subsidiary cells.

The cell walls of both upper and lower epidermis are irregular with fimbriated margins in case of *Achyranthes* (figures 13, 14), *Digera* (figures 7, 8), *Amaranthus gracilis* (figures 3, 4), *A. tricolour* (figures 5, 6) and *A. blitum* var. *oleracea* (figures 1, 2). However, in *Iresine* (figures 21, 22), *Pupalia* (figures 9, 10) and *Aerva tomentosa* (figures 15, 16), the lower epidermis has sinuous cell walls while the upper epidermis has almost smooth walls. *Aerva lanata* (figures 11, 12) which is an exception in the tribe Amarantae, has almost smooth walls in both upper and lower surfaces. Both the species, *Celosia cristata* and *C. argentea* investigated from tribe celosieae have sinuous cell walls in lower epidermis while upper surface showed almost smooth walls (figures 17–20). *Alternanthera* and *Gomphrena* both have nearly smooth walls on the two surfaces of leaf.

The measurements of various epidermal characters such as stomatal size, frequency etc in the different species are presented in table 1. Amphistomatic leaves of *Celosia argentea, Digera alternifolia, Aerva lanata, Achyranthes aspera* and *Alternanthera pungens* had almost identical stomatal indices of both upper and lower surfaces. The rest of the species investigated showed the usual trend of higher stomatal index on lower surface as compared to the upper ones. In Amarantae tribe, *Aerva tomentosa* possessed sunken stomata (figures 15, 16) on both the surface while *Digera alternifolia* has only on the lower surface of leaf (figure 8).

Distribution of hairs was quite variable. In some of the species the hairs were present to its negligible frequency, as in *Celosia argentea, Amaranthus tricolour, A. gracilis, A. blitum* var *oleracea, Digera alternifolia* while in *Celosia cristata* and *Aerva lanata,*



Figures 1–26. Figures with odd numbers represent the upper epidermal while even numbers represent the lower epidermal surfaces (for details see text).

trichomes were spotted having lesser frequency. A rich distribution was observed in *Aerva tomentosa*, *Achyranthes aspera*, *Pupalia lappacea* and *Iresine lindenii*, the distribution being profuse in the first two species. The trichomes are capitate, unicellular with ellipsoidal or spheroidal heads as in *Amaranthus tricolour*, *A. gracilis*, *Gomphrena* and *Iresine*, and in *Aerva lanata*, these were uniseriate pappillose type. Contrary to this *Aerva tomentosa* possessed stellate type of hairs. In *Alternanthera* and *Pupalia*, the hairs were multicellular but linear type.

3 October 1984; Revised 1 April 1985

Table 1 *Measurements of stomatal size (μ) and frequency*

Species	Ploidy level $2n =$	Size of stomata (μ)		Stomatal index		Trichomes	
		Lower	Upper	Lower	Upper	Lower	Upper
Celosieae							
Celosia cristata	36	26 × 21	24 × 21	27.8	14.1	–	–
Celosia argentea	36	33 × 23	32 × 23	29.8	25.5		–
Amarantae							
Amaranthus tricolour	34	26 × 22	25 × 19	15.5	3.7	–	–
A. gracilis	34	26 × 19	23 × 16	35.0	21.0	–	–
A. blitum var. oleracea	16	27 × 17	27 × 19	32.5	21.0	–	–
Digera alternifolia	12	27 × 19	28 × 18	23.5	21.6	–	–
Aerva lanata	16	25 × 17	25 × 17	19.1	17.1	+	–
Aerva tomentosa	36	24 × 19	29 × 22	22.0	9.8	+ + +	+ +
Pupalia lappacea	50	30 × 23	28 × 22	24.3	10.2	+ +	+
Achyranthes aspera	14	24 × 17	26 × 18	31.3	26.2	+ + +	+ +
Iresine lindenii	*	18 × 16	23 × 18	26.8	13.4	+ +	+
Gomphreneae							
Alternanthera pungens	68	28 × 22	23 × 17	23.2	19.5	+	+
Gomphrena globosa	32	31 × 23	28 × 33	22.2	15.0	+	+ +

– absent; + low frequency; + + moderate frequency; + + + high frequency; * not known.

1. Metcalfe, C. R. and Chalk, L., *Anatomy of dicotyledons*, Vol. I. Clarendron Press, Oxford, 1950.
2. Stebbins. G. L., *Am. J. Bot.*, 1956, **43**, 890.
3. Stebbins, G. L. and Khush, G. S., *Am. J. Bot.*, 1961, **48**, 51.
4. Kaushik, J. P., *Proc. Indian Acad. Sci.*, 1971, **B73**, 311.
5. Salisbury, E. J., *Philos. Trans. R. Soc. (London)*, 1927, **216**, 1.

THE ACTION OF MALEIC HYDRAZIDE ON *EUASTRUM VERRUCOSUM* EHRENB

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VERY little information is available on the mitotic inhibition and chromosome aberrations in various angiosperm plants[1-4] although the effect of maleic hydrazide on algal members was studied[5-11]. During the present investigation the effect of maleic hydrazide was studied on one of the placoderm desmid *Euastrum verrucosum* Ehrenb.

The clonal unialgal cultures were established in Chu 10 inorganic medium and maintained at 21 + 2° C, receiving alternately 16 hr light and 8 hr dark periods. The species was treated with various concentrations of maleic hydrazide (0.0001%, 0.001%, 0.01%, 0.1% and 1%). Fixation was made after 48 hr of the treatment with different concentrations of the chemical for cytological studies. Godward's[12] acetocarmine method was followed in fixing and staining the cells. Ten slides were prepared from the treated sample and from each slide 10 fields of view were scored for mitotic index and cytological observations.

The increasing concentration of the chemical showed inhibition of cell division (figure 2). Regarding cytological variations, among all the concentrations employed, 0.01% concentration showed maximum chromosome breakage (figure 1B). The normal chromosome number in the species being $n = 16$ (figure 1A).

It was observed that with increasing concentration of maleic hydrazide there was a gradual decline in the mitotic, division compared to control. Chromosome breakages obtained with the concentration of 0.01% maleic hydrazide was similar as shown earlier[8] on *Vicia faba*.

The authors are thankful to CSIR for financial help.

25 February 1985

1. Lobov Yavosakaya, V. K. and Kalinin, F. A., *Cytol. Gen.*, 1969, **3**, 218.
2. Ammini, H. C., *Sci. Cult.*, 1968, **34**, 490.
3. Popa, L. N. E., *Genetica*, 1969, **5**, 53.
4. Zuk, J. and Swietlinska, Z., *Genet. Pol.*, 1973, **14**, 173.