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Leaf Epidermal Features of *Ageratum conyzoides, Aspilia africana, Chromolaena odorata and Tridax procumbens* (Asteraceae).

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ABSTRACT: The leaf epidermal features of four species within the family *Asteraceae,*namely *Ageratum conyzides, Aspilia Africana, Chromolaena odorata* and *Tridax procumbens,* were investigated using the traditional peeling technique. Results show that stomata in the four species are anomocytic (ranuculaceous). The average size of guard cells is 33.00 x 24.00µ in *Ageratum conyzoides,* 30.03 x 25.03µ in *Aspilia Africana,* 30.75 x 27.89µ in *C. odorata,* and 50.05 x 43.62µ in *T. procumbens*. The average size of epidermal cells is 79.00 x 44.00µ, 39.33 x 30.03µ, 42.90 x 30.75µ and 78.65 x 64.35µ in the four species respectively. The average stomatal frequency per unit area is 112,109,117 and 68 respectively while the average frequency of epidermal cells per unit area is 408, 382, 419 and 250 respectively. The Stomatal index is 21.56, 22.18, 21.76 and 21.38 respectively. The taxonomic and phylogenetic values of the above epidermal indices were discussed.

KEY WORDS: Leaf, Epidermal features, *Ageratum conyzoides, Aspilia africana, Chromolaena odorata, Tridax*

INTRODUCTION

The four species *Ageratum conyzoides, Aspilia africana, Chromolaena odorata and Tridax procumbens* belong to the family *Asteraceae (*Compositae). This family is the largest family of flowering plants comprising of 1,100 genera and 20,000 species. (Omotable, 1965). This family is cosmopolitan and has a very effective pollination mechanism (Shukka and Misra, 1994). Members are mainly herbaceous, some shrubs and few trees. The leaves are simple, alternate, opposite or commonly whorled. The presence of the inflorescence distinctively distinguished this family from all other families of flowering plants. Inflorescence consists of several small flowers that are crowded together, sessile on a receptacle (Hutchinson and Dalziel, 1963). This inflorescence is after mistaken for a single flower but what looks like an ordinary flower is actually a composite of small florets. The inflorescence is called a Capitulum or head. Each capitulum is surrounded and protected by green bracts called involucral bracts and the whole structure is referred to as involucre.

Many members of the *Asteraceae* are cultivated for ornamental purpose. These include such well known plants as Asters, Chrysanthemums, Diahlias, Heleniums and the so called everlasting plants from South Africa, belonging to the genus *Helichrysum* and its allies. Edible plants include the Jerusalem artichoke (*Helianthus tuberosus)* and Cassava (*Manihot esculenta*) of which the tubers are eaten. Some species yield latex. However, no member of the family is well established as a commercial source of rubber. This is because the yield of rubber is small and the quality is poor when compared with those of the Para rubber tree (*Hevea brasiliensis).*

The epidermal features of leaves have received considerable attention from botanists as reviewed by Stace (1965a), and Sinclair and Sharma (1971) of previous studies in this field indicate. Epidermal characters were initially used by only Palaebotanists in the classification of non-angiosperms. Their application later to modern angiosperms showed that they can be a very important tool of the taxonomists and the evolutionists. Following this discovery, epidermal features became widely studied from three main perspectives-ontogenetic, phylogenetic and taxonomic. Ontogenetic investigations have tended to show the methods of origin of the different stomatal types. This has resulted to the classification of stomata based on their ontogeny (Stebbins and Jain, 1960; Pant, 1965; Van Cotthem, 1970). Phylogenetic considerations make use of the presumed relationships between the different patterns of stomatal ontogeny in proposing evolutionary pathways within or between taxa. Studies of this nature have been carried out by many authors including Campbell (1962).

The use of epidermal characters such as stomatal types, trichome types, stomatal frequency or index in classification seems to be increasing rapidly because not only do epidermal characters correlate with gross morphological features in most cases, they are often known to be very valuable at the levels where classical methods of cytology and genetics cannot be applied. (Stace, 1965a). in dicotyledons, the systematic value of epidermal and cuticular features has been indicated by many authors. For example, Stace (1965a, 1965b, 1969a, 1969b) has made extensive comparative studies in the tropical mangrove families; Combretaceae, Rhizophoraceae and Avicenniaceae. He pointed out that in the Combretaceae, the following stomatal features are taxonomically important at the species level: the degree and patterns of thickening of the guard cell walls, particularly regarding the stomatal edges, the degree of sunkeness of the guard cells in surface view: and the size is very important, hence the genus *Strephonema* with a two subsidiary cells surrounding the guard cells can be easily distinguished from other genera where subsidiary cells are lacking in the epidermis.

Perhaps, the most extensively investigated family where epidermal features provide very useful taxonomic characters is the Gramineae, and several authors (e.g. Davis, 1959) have constructed keys for the identification of some taxa within the family based only on leaf epidermal characters. The most recent method is the study of leaf surfaces by means of the Scanning Electron Microscope (Heywood, 1973; Cutler, 1975). The technique is

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particularly useful because it reveals details of the topography of both the outer and the inner layers of the cuticles which cannot be examined by earlier methods.

In the family Asteraceae, stomata are variously distributed, mostly ranuculaceous to cruciferous. Stomata are absent from submerged, but present on both surfaces of aerial leaves of the aquatic *Megalodonta beckii.* Small groups of stomata occur on both surfaces and areas of assimilatory tissue in *Grindelia squarrota* (Homl, 1910; Hoech, 1914; Metcalf and Chalk, 1972).

Literature survey suggests that anatomical studies in the *Asteraceae* are mostly in the temperate members. Tropical genera and species are yet to be given deserving attention. The objective of this study is to determine whether or not the four tropical species selected for this study conform to the general epidermal features described for the temperate taxa by authors.

MATERIALS AND METHODS

Ageratum conyzoides Aspilia Africana, Chromolaena odorata and *Tridax procumbens* were collected from three different locations all within Imo State University, Owerri. Three fresh mature leaves from each of the specimens were collected per species from the middle portion of their stem. The leaves were washed in tap water. The study was carried out in Plant Science and Biotechnology Departmental Laboratory.

The leaves were immersed in bowl of water to facilitate peeling. Peeling was done by means of a sharp razor blade from the lower (abaxial) surface of the leaves. The peels were mounted on slides and observed under a light microscope.

Twenty slides were prepared per species and studied. Determination of stomatal type was carried out in accordance with Van Cotthem (1970). Ten out of the twenty slides were selected per species for size measurements. One hundred size measurements were made per species from the ten selected slides using a micrometer. Frequency counts per unit area were also made from the ten slides selected per species. The unit area used was the field of view of the microscope at x10.

Finally, three different counts were made from different portions of each slide. These gave a total of thirty frequency counts per species. Data accruing from the measurements and counts were organized and presented in Table 1. photographs illustrating the epidermal features were obtained using a photomicroscope. Stomatal index (S.I.) per species was calculated using the equation below:

$$S.I = \frac{S}{E+S} \times 100$$

Where S = number of stomata
E = number of Epidermal cells

RESULTS

The epidermal features of the four species are presented below. Stomata are anomocytic in the four taxa (Figs 1 and 2). Other features are described according to species. In *Ageratum conyzoides,* guard cells measured 22.88 - 42.90µ long. Average length was 32.89µ. Width record was 15.75 31.46µ. average width was 23.60µ. Epidermal cells measured 30.03 128.70µ long. Average length was 79.37µ. The width ranged from 18.59 to 70.07µ. Average width was 44.33µ (Table 1). The frequency of stomata per unit area was 67 157 and the average 112. The epidermal cells had a frequency of 241 574 with an average of 408. Stomatal index was 21.56 (Table 1).

The size, frequency and stomatal index records of *Aspilia Africana, Chromolaena odorata* and *tridax procumbens* are also as presented in table 1.

DISCUSSION

The results of this study revealed that the four species do not show much differentiation in their epidermal features. In the first instance, all the stomata in the four species are anomocytic. The average length of guard cells is 30.03µ in *Aspilia Africana,* 30.75µ in *C. odorata* and 33.00µ in *Ageratum conyzoides*. The same three species appear close in their respective average widths (25.03, 27.89 and 24µ) of their guard cells. On the other hand, *T. procumbens* differs largely from the three species mentioned above as the average length of guard cells is 50.05µ and the average width 43.62 (table 1). This indicates that *T. procumbens* can easily be separated from the other three species mentioned above based on the sizes of their guard cells.

The same relationship as above is maintained when the minimum size of the epidermal cells of each species is compared. In *Ageratum conyzoides,* the minimum size is 30.03 x 18.59µ. In *Aspilia Africana*, it is 21.45 x 17.16µ; while in *C. odorata*, it is 28.60 x 17.16µ. These three species again appear closer to one another than to *T. procumbens* with a minimum size of epidermal cells of 42.90 x 28.60µ. (Table 1).

Furthermore, the same relationships as above are maintained when such indices as frequency of stomata and frequency of epidermal cells are applied in the assessment of the four species (Table 1).

Another interesting result arising from this study is the inverse relationship between size (whether of guard cells or epidermal cells) and frequency (of stomata or epidermal cells (Table 1). This is so because large cells under the same unit area should yield lower cell counts, and vice versa. Stomatal index is almost 22 per species (Table 1) and so appears to have no taxonomic value as far as the four species are concerned.

The four species involved in this study have anomocytic (ranuculaceous) stomata. This agrees with the stomatal type reported by Metcalf and Chalk (1972) for the family Asteraceae. From the phylogenetic classification of stomatal types by Van Cotthem (1970), ranuculaceous (anomocytic) stomata are the most primitive. One might then wonder why the most primitive type of stomata can occur in the Asteraceae, which is one of the most advanced families of flowering plants. The explanation is that evolution does not affect plant tissues and organs at the same time and in the same degree. Furthermore, some organs and tissues are not affected by evolutionary forces at all (Davies and Heywood, 1973).

Table 1: Epidermal Features of the Four Species of Asteraceae Studied

Species	Type of Stomata	Size of guard Cells		Size of Epidermal Cell		Frequency of Stomata Per Unit Area*	Frequency of Epidermal cell Per unit area*	Stomatal Index (%) (S.I)**
		L(μ)	W(μ)	L(μ)	W(μ)			
Ageratum conyzoides	Anomocytic	22.88–42.90 (33)	15.75 – 31.46 (24)	30.03-128.70 (79)	18.59-70.07 (44)	67-157 (112)	241-574 (408)	21.56
Aspilia africana	Anomocytic	17.16-42.90 (30.03)	14.30-35.75 (25.03)	21.45-57.20 (39.33)	17.16-42.90 (30.03)	57-161 (109)	186-579 (382)	22.18
Chromolaena odorata	Anomocytic	25.74-35.75 (30.75)	15.73-40.04 (27.89)	28.60-57.20 (42.90)	17.16-44.33 (30.75)	73-160 (117)	262-576 (419)	21.76
Tridax procumbens	Anomocytic	40.04-60.06 (50.05)	35.75-51.48 (43.62)	42.90-114.40 (78.65)	28.60-100.10 (64.35)	43-93 (68)	155-345 (250)	21.38

Note * = Unit area used was the field of view of the microscope

** = Stomatal index = S.I = S.I = $\frac{S}{E + S} \times 100$

Where S = number of stomata E = number of epidermal cells

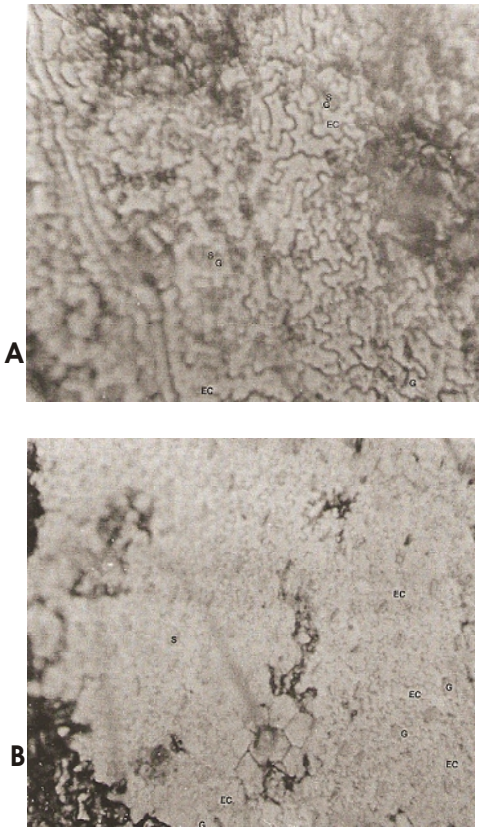

Fig 1: Leaf Epidermal features of
A = *Ageratum conyzoides* B = *Aspilia africana*
S= Stoma, G =Guard cell, E = Epidermal Cell

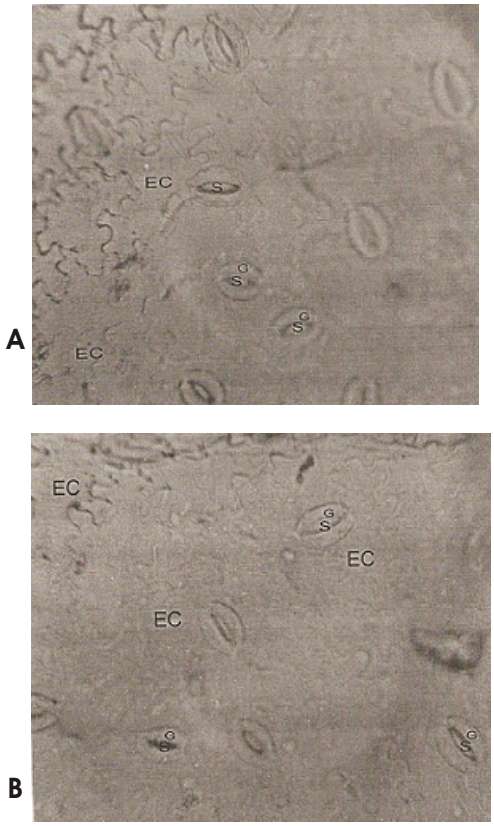

Fig *2*: Leaf Epidermal features of
A = Chromolaena odorata B = Tridax procumbens
S= Stoma, G =Guard cell, EC = Epidermal Cell

CONCLUSION AND RECOMMENDATION

The results of this study show that epidermal features are not very useful at species and genera levels. However, they are valuable at the family level. Secondly, epidermal features have not contributed to the advanced position of the family. In West Africa, detailed studies of the epidermal features have not been carried out. The above conclusions were based mainly on this study in which very few species and genera were involved. Detailed studies are needed to ascertain the true taxonomic and phylogenetic value of epidermal features in the *Asteraceae.*

REFERENCES

Campbell, C.C (1962). A study of the genus *Datura* based on cuticular characters. Thesis: Missouri University, Columbia.

Cutler, D.F (1975). Anatomical notes on the leaf of Eluitharrhena and Pycnarrhenal (Menispermaceae) Kew Bull Bulletin 30: 41-48.

Davies, I (1959). The use of epidermal characteristics for the identification of grasses in the leafy stage. *Journal of the British Grassland Society 14:7-16*

Davis, P.H and Heywood, V.H (1973). Principles of angiosperm taxonomy. New York: Robert. Krieger Publishing Company.

Heywood, V.H (1973). L'Emploi de la microscopic electronique a balauage dans les e'tudes de phytodermologie. 96e congr. Nat. Soc. Sav. Toulouse. 5:345-357.

Hoeck, A.V (1914). The anatomy of Megalodonta beckii. American Midland Naturalist 3:336-342.

Homl, T (1910). Grindelia squarrosa (Pursh) Dunal. Merck's Rep., 19:310-312.

Hutchinson, J and Dalziel, J.M (1963). Flora of West Tropical Africa. Vol 2. whitefrrars Press Ltd.

Metcalfe, C.R and Chalk, 1 (1972). Anatomy of the dicotyledons. Vol II, Oxford: the Clarendon press.

Omotable, O (1965). Taxonomy of West African Flowering Plants. Longman group. Ltd.

Pant, D.D (1965). On the Ontogeny of Stomata and other Homologous Structures. Plant Science. Ser. 1:1-24.

Shukla, A and Misra, S.P. (1994). An Introduction to Taxonomy of Angiosperms.

Sinclair, C.B and Sharma, G.K (1971). *Epidermal and Cuticular Studies of Leaves. J. Tennesses Acad. Sci 46*:2-11.

Stace, C.A (1965a). Cuticular Studies as an aid to Plant Taxonomy, Bull. Brit. Mus. Nat. Hist., Ser. E 3(1):1-78.

Stace, C.A (1965b). The Significance of the Leaf Epidermis in the taxonomy of *Combretaceae* I. A general review of tribal, generic and specific characters. J. Linn. Soc. Bot., 59:229-252.

Stace, C.A. (1969a). The significance of Leaf Epidermis in the Taxonomy of the *Combretaceae* II. The genus *Combretum* subgenus *Combretum* in Africa. *J. Linn. Soc. Bot., 62*:131-168.

Stace, C.A. (1969b). The significance of Leaf Epidermis in the Taxonomy of the Combretaceae III. The genus *Combretum* in America. Britonia 21:130-143.

Stebbins, G.L and jain, S.K (1960). Developmental Studies of cell Differentiation in the epidermis of Monocotyledons and its bearing on the phylogeny. *Dev. Bio. 2*: 409-426.

Van Cotthem, W.R (1970). A classification of stomatal Types. *Botanical Journal of the linnean*.