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FOLIAR EPIDERMAL FEATURES IN CERTAIN SPECIES OF *EUPHORBIA* L. (EUPHORBIACEAE) IN NIGERIA

B. C. NDUKWU AND B. E. OKOLI

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ABSTRACT

An investigation of foliar micromorphological features of twenty-five species in the genus *Euphorbia* L. found in Nigeria was conducted using light microscope, in order to determine their suitability for taxonomic delimitation. Seventeen of the species showed only anomocytic stomata, five species had only paracytic type, two displayed a mixture of anomocytic and paracytic stomata while the remaining two showed combination of anomocytic and staurocytic types. The stomatal index varied significantly from 9.54 in *E. posionii* to 34.16 in *E. sanguinea.* Though the species were generally hypoamphistomatic, variations were observed on the length and width of the stomatal complexes. Four species *E. cyathophora, E glaucophylla, E. heterophylla* and *E. hypericifolia* showed cuticular striations. Trichomes occurred in eight species, and showed variations in size, density, branching patterns and surface ornamentation. The usefulness of these features in deciphering the taxonomic delimitation of the species is discussed.

KEYWORDS: *Euphorbia,* micromophology, epidermal feature.

INTRODUCTION

Euphorbia L. is the largest genus not only in the family Euphorbiaceae but also in the plant kingdom, numbering about 2, 000 species distributed mostly in the tropics, subtropics and warm temperate regions of the world (Willis, 1966). In Africa alone, over 200 species have been recorded (Verdcourt and Trump, 1969). This number includes about 22 species recorded for Nigeria (Gbile, 1979) excluding the few introduced species and those not yet deposited in Forestry Herbarium, Ibadan (FHI). Economically, many of the species of *Euphorbia* L. are used for traditional treatment of various ailments (Dalziel, 1937, Gbile, 1979). It has also been reported that the species of *Euphorbia* L. are rich in various hydrocarbon compounds similar to those in crude oil (Sternburg and Rodbrigue, 1982). Moreover, Okoli *et al.* (1989) had reported the usefulness of *Euphorbia* L. species as commercial sources of tannins, waxes and alcohols. The usefulness of *Euphorbia* L. species as hedge, ornamental and fodder crops emphasizes the value they have among the traditional people of Nigeria.

The value of leaf epidermal characteristics in comparative anatomy and taxonomy is well documented in botanical literature; (Esau, 1960; Stace, 1965; Dehgan, 1979, 1980; Olowokudejo, 1990; Cantino, 1990; Edeoga, H. O. 1991; Faden 1991; Nyawuame & Gill, 1999; Ascenosao *et al*, 1995; Edeoga & Ikem, 1999). In particular, Epidermal characters of some members of Euphorbiaceae have been studied by Amelunxen *et al* (1967); Kukkar and Paliwal (1974); Raju and Rao (1977); Dehgan (1980).

The records available indicate that no systematic studies of epidermal features have been carried out on Nigeria species of *Euphorbia* L. Thus, the aim of this investigation is to provide detailed information on the leaf epidermal characteristics of the species of *Euphorbia* L. with a view to establishing the value of these characters as taxonomic markers.

MATERIAL AND METHODS

Mature leaves of 25 species of *Euphorbia* L. consisting of both fresh and herbarium specimens were used in the study. Fresh materials were fixed directly into the fixative – (FAA) while herbarium materials were first boiled for about 10 minutes before being fixed. These previously fixed materials were used for the epidermal studies following the method of Cutler (1978). The epidermal peels were stained with 1% safranin and temporarily mounted in aqueous glycerine solution. The slides were examined and photomicrographs taken using a Leitz Laborlux 12 microscope fitted with WILD-MPS camera.

The stomatal index was also calculated while the stomatal types were described using the terminologies of Rasmussen (1981). The morphology of the trichomes was described following Metcalfe and Chalk (1950). The mean length of each type of trichome studied was obtained from 10 measurements made with a calibrated eyepiece graticle. The density (abundance) and distribution of the trichomes on different organs of the species were computed following the methods of Olowkudejo (1990).

RESULTS

The result of foliar stomatal characteristics investigated in a total of 25 species of *Euphorbia* is summarized in Table 1. All the measurements were made from the abaxial leaf surfaces, which had more stomata. All the leaves examined however showed hypoamhistomatic distribution though the frequencies varied from species to species.

Anomocytic stomata were the only type observed in 17 species namely *E. balsamifera, E cyathophora, E. convolvuloides* (Fig. 1), *E. depauperata, E. fosskalli, E. heterophylla, E. hirta* (Fig. 2), *E. hypericifolia, E. lateriflora* (Fig. 4), *E. leucophylla, E. prostrata, E. pulcherrima* (Fig. 6), *E. sanguinea, E. scordifolia* (Fig. 7), *E. tirucalli* and *E. thymifolia.* A mixture of anomocytic and staurocytic types was observed in two species: *E. glaucophylla* and *E. polycnemoides* (Fig. 5) while *E. millii* showed a mixture of anomocytic and paracytic stomatal types. Paracytic stomata were the only type found in five taxa namely *E. desmondi, E. kamerunica* (Fig. 3), *E. ledermanniana, E. poissoni* and *E. royaleana.* It was also observed that all the taxa showing paracytic stomatal types possess thick and fleshy leaves while anomocytic and staurocytic types were present in non-fleshy thin leaves. *E. milli* which showed a mixture of anomocytic and paracytic types of stomata was observed to be fairly thick and fleshy especially when the leaves are young.

Cuticular ornamentations were observed in *E. cyathophota, E. glaucophylla, E. heterophylla* and *E. hypericifolia* (Fig 8). The stomata *in E. desmondi, E. kamerunica* (Fig. 3) *E. ledermanniana, E,. poissoni* and *E. royaleana* were to be sunken under the neighouring epidermal cells.

The stomatal index (S.I.) recorded after subjecting the original

B. C. Ndukwu, Department of Plant Science and Biotechnology, University of Port Harcourt, P. M. B. 5323, Port Harcourt, Nigeria.
B. E. Okoli, Department of Plant Science and Biotechnology, University of Port Harcourt, P. M. B. 5323, Port Harcourt, Nigeria.

data to statistical analysis varied from 9.54% in *E. poissoni* to 36.08% in *E heterophylla*.

The trichomes observed among the species were generally the simple, unbranched, multicellular, non-glandular and multi-separate types. A summary of the types, nature and distributed of these trichomes is presented in Table 2. A total of eight species showed the presence of different types of trichomes. The relative length of the trichomes on mature leaves varied from 44.9± 9.94um in *E. heterophylla* to 835 ± 21.21 um in *E. hirta*.

In terms of the density, it ranges from sparsely hairy (11-29%) in *E. cyathophora* and *E. convolvuloides* and three other species. The other 17 taxa of *Euphorbia* examined showed no trichomes on the mature organs of the leaves or even other parts. These are thus termed glabrous.

Table 1: Summary of Foliar Stomatal and Epidermal Features of the *Euphorbia* Species Studied

Name of Species	Stomatal Types	S. I	Other Remarks
E. balsamifera Ait	Anomocytic	34.33	-
E. convolvuloides Hochst ex Benth	Anomocytic	28.83	-
E. cyathophora Murr.	Anomocytic	33.16	Cuticle Ornamention
E. depauperata Hochst ex. A. Rich.	Anomocytic	21.23	-
E. desmondi Keay & Milne-Redh.	Paracytic	22.03	Sunken Stomata
E. forsskalli J. Gay	Anomocytic	21.70	-
E. glaucophylla Poir	Anomocytic & Staurocytic		Cuticle Ornamentation
E. heterophylla L.	Anomocytic	14.71	-
E. hirta L.	Anomocytic	38.08	-
E. hypericifolia L.	Anomocytic	28.34	Cuticle ornamentation
E. hyssopifolia L.	Anomocytic	23.30	
E. Kamerunica Pax	Paracytic	20.46	Sunken stomata
E. lateriflora Schum & Thom.	Anomocytic	16.53	
E. ledermonniana Pax & K. Hoffm	Paracytic	21.80	Sunken Stomata
E. leucophylaa Benth	Anomocytic	21.23	-
E. milii Des Mow	Anomocytic & Paracytic	19.67	-
E. poissoni Pax	Paracytic	9.54	Sunken Stomata
E. polycnemoides Hochest ex Boiss	Anomocytic & staurocytic	21.99	-
E. prostrata Ait	Anomocytic	24.03	-
E. Pulcherrima Wild ex Klotzsch	Anomocytic	32.20	-
E. royaleana L.	Paracytic	10.22	Sunken Stomata
E. sanguinea Ort.	Anomocytic	34.16	-
E. scordifolia jacq.	Anomocytic	20.10	-
E. tirucalli L.	Anomocytic	23.01	-
E. thymifolia L.	Anomocytic	29.11	-

Table 2: Summary of Morphology and Distribution of Trichomes in *Euphorbia* Species studied.

Name of Species	Relative Length in um	Density
E. convolvuloides. Hochst ex Benth	348 ± 14.76	Very density hairy (>50%)
E. cyathophora Murr.	447± 14.94	Sparsely hairy (11-29%)
E. hetetophylla L	449± 9.94	Sparsely hairy (11-29%)
E hirta L	835± 21.21	Very densely hairy (>50%)
E. prostrate Ait	234± 15.06	Densely hairy (30-49%)
E. pulcherrima Willd.ex klotzsch	741± 15.06	Densely hairy (30-49%)
E. scordifolia Jacq	702± 28.21	Very densely hairy (>50%)
E.thymifolia L	725± 17.16	Very densely hairy (>50%)

*(Modified after Olowokudejo, 1990) **Note**: Taxa with complete absence of trichomes have been deliberately excluded in the table.

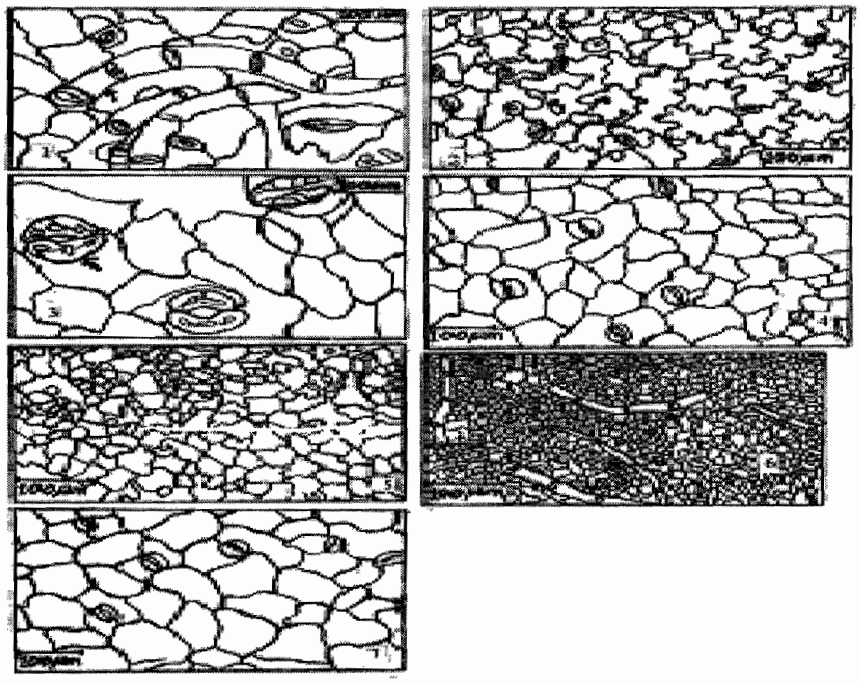

Figure 1 – 7: Photomicrographs showing Various Epidermal Features in some *Euphorbia* Species. *E. convolvuloides* (Fig. 1 – note *trichome*); *E. hirta* (Fig. 2): *E. kamerunica* (Fig. 3 – note sunken stomata); *E. lateriflora* (Fig. 4); *E. polycnemoides* (Fig. 5); *E. pulcherima* (Fig. 6 – note *trichomes*): and *E. scordifolia* (Fig. 7).

DISCUSSION

Stomatal characteristics including types, distribution and index varied significantly among the *Euphorbia* L. species investigated. All the species, however, were observed to be hypoamphistomatic. These features probably suggest that all the species are evolutionarily related despite other differences. Of the four types of stomata observed in the taxa studied, anomocytic and paracytic types were most frequent. The association of paracytic stomatal types with large and succulent leaves is noteworthy. This situation suggest that in the paracytic arrangement, the parallel position of the subsidiary cells in relation to the guard cell probably helps to impart necessary support during the osmotic changes associated with stomatal movements. This fact tends to agree with the earlier report by Esau (1960) and Nyawuame and Gill (1991) that the subsidiary cells surrounding the guard cells probably participate in the osmotic changes involved in the movement of the guard cells. The fact may be appreciated if it is noted that osmotic changes in the large stomata of thick leaves will certainly exert more pressure on the neighbouring cells and thus will require more support than the case in small stomata.

The data on stomatal types can be used to delineate the *Euphorbia* species studied into four categories. These are 17 species with only anomocytic type, five with paracytic arrangement, two with a mixture of anomocytic and staurocytic types. Only one species *E milii* showed a mixture of anomocytic and paracyic types. The presence of these two kinds of stomatal types in *E milii* may be due to the mild thickness exhibited by the leaves, or perhaps it may be a hybrid.

The stomatal size and index varied from species to species and can thus be use in the delimitation of the various taxa. For instance, the stomatal index of 34.33 in *E balsamifera* varies from that of *E desmondi,* which is 12.03. The reduced stomatal index of species with succulent leaves and large stomatal is noteworthy. This correlation could be more of adaptation than functional. The size, shape and outline of the other epidermal cell varied considerably thus, their features can be harnessed for taxonomic purposed.

The walls of these cells show different levels of contortions and ornamentations due to the deposition of cuticle. Thus, in species such as *E. cyathophora, E. glaucophylla, E. heterophylla* and *E hypericifolia* there was intense ornamentation arising from heavy cuticle deposition on the epidermal cells. This character appears to be more of an adaptation accounting for the success of these predominantly weedy species.

Metcalfe and Chalk (1950) and Cantino (1990) had already reported on the usefulness of trichomes (epidermal hairs) in taxonomic delimitation of taxa. In *Euphorbia,* the presence, distribution, length and density of the trichomes are the taxonomically important aspects since only one type (simple, unbranched) or trichome is observed in the genus. In all, only eight out of the 25 species studied possess trichomes. The length of the trichomes varied from 234 ± 15.06 um in *E. prostrate* to 835 ± 21.21 um in *E. hirta.*

The density of trichomes indicates that while *E. cyathophora* and *E heterophylla* were sparsely hairy (11-29%), *E. convolvuloides, E. Scordifolia* and *E. thymifolia* were very densely hairy (>50%). Dehgan (1980) and Olowokudejo (1990) using *Jatropha* and *Annona* had reported the usefulness of trichome density in taxa delineation.

In *Euphobia* species therefore, trichome density can be exploited for the taxonomic delimitation of the species.

In the light of the results, epidermal characteristics such as stomatal types, size, index, presence and density of trichomes can provide information upon which comprehensive classification of *Euphobia* species could be based.

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