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Stomata Complex in Some Shrubs and Trees

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ABSTRACT

Twenty taxa comprising of 13 shrubs and 7 trees, distributed in 13 orders and 13 angiospermic families were documented with descriptions for nature of stomata. The epidermal cells are generally arched as found in 17 taxa, with 3 wavy forms. Anomocytic, anisocytic, paracytic, diacytic, tetracytic and mixed stomata were observed. Stomata size ranging from 18.89 x 13.40µm in *Solanum torvum* to 34.23 x 24.55µm in *Tabernaemontana pachysiphon* and stomata index values varying from 4 in *Macaranga barteri* to 24% in *Glyphaea brevis* were recorded in this study.
Keywords: Leaf Epidermis, Stomata Type and Size, Shrubs and Trees.

INTRODUCTION

Trees and shrubs constitute woody species because of the hardy nature of their plants stem. Keay et al., (1964 a, b) documented over 900 Nigerian tree species, also Hutchinson and Dalziel (1954, 1958, 1963) recorded more than 300 Nigerian shrubby species. In addition, woody and shrubby species are being introduced for soil, water and air conservation purposes, for their edibility, decorative, medicinal, as bio-fuels, industrial and other uses. Though, recent records depict abysmal number of 560 indigenous and naturalized trees species due to deforestation and poor tree management practices (Gani, 2011).

Stomata serves for gaseous communication between the internal and external environments of an higher green plant (Swarthout, 2008). Stomata are minute functional pores on the leaf and some stem epidermis (Roberts, 1978). Physiological functions like photosynthesis, respiration and transpiration takes place with the help of stomata, as it is through them, that inter- change of gases such as oxygen carbon-dioxide and also water vapour passes between the inter-cellular space system of the internal tissues of the higher green plant and the outer atmosphere (Pandey and Chadha, 2006). Stomata can also be diagnostic as a systematic tool in the classification of problematic higher plants taxa (Ogbe and Osawaru, 1988).

Earlier contributors on phyto-dermology of shrubs and trees covering many plant families worldwide include Metcalfe and Chalk, 1950a, 1950b, Metcalfe, 1979. Camargo and Marenco (2011) reported stomatal features in 35 rain forest tree species in central Amazonia, South America. In Nigeria, Gill and Nyawuame, (1990), reported stomata of Bicarpellatae woody taxa, Idu *et. al*, 2000 reported on stomata features on Fabaceae tree. In spite of the importance of the stomatal apparatus in plant physiology and taxonomy information on it's structure and size in Nigerian woody species is scanty, this study reports stomatal structure and size in some Nigerian woody species.

MATERIALS AND METHODS

Leaf specimens collected and later deposited as voucher materials at the University of Benin Herbarium were used for the study. The designation OB- represent voucher specimens collected and used for the study. All collection were made in Benin City, Nigeria and its environments.

Abaxial leaf surface records only were taken because of confinement constancy of stomata on lower leaf surface. The leaf portions were decolourised by immersion in 90% alcohol and were washed in 5 changes of distilled water, after which they were immersed in 5% sodium hydroxide and introduced to boiled distilled water at 100^0C for ten minutes to further enhance leaf de-colorization and later washed in 5 changes of distilled water after which they were mounted.

Terminologies of stomata complex types used after Metcalfe and Chalk, (1950a, 1979), Rasmussen, (1981). Measurements were carried out on 35 stomata for each taxon investigated with ocular graticule using a Swift Collegiate light microscope. The number of stomata per field of view was recorded. Stomata index after Dilcher (1974) was calculated as a percentage of the number of epidermal cells plus stomata per unit area.

$$\text{S.I} = \frac{S}{E+S} x \frac{100}{1}$$

For statistical analysis, Standard error was determined for all taxa.

RESULTS

Qualitative and Quantitative Stomata Characters of the Dicotyledonous Families studied are listed alphabetically.

Table 1: Qualitative stomata characters of The Woody Species

S/N	Taxon	HABIT	Voucher Specimen	Epidermal Cell	Stomata Type
1.	Order Apocynales Family Apocynaceae *Tabernaemontana pachysiphon* Stapf.,	Tree	OB-021	Arched	Paracytic and Tetracytic
2.	Order Boraginales Family Boraginaceae *Cordia aurantiaca* Bak.,	Tree	OB-016	Wavy	Anomocytic, Anisocytic and Paracytic
3.	Order Myrtales Family Combretaceae *Combretum platypterum* (Welw) Hutch and Dalz.,	Shrub	OB-019	Wavy	Anomocytic
4.	Order Euphorbiales Family Euphorbiaceae *Alchornea cordifolia* (Schum and Thonn.,) Muell. Arg.,	Shrub	OB-018	Arched	Paracytic
5.	*A. laxiflora* (Benth.,) Pax and K. Hoffm.,	Shrub	OB-017	Arched	Anomocytic
6.	*Discoglypremna caloneura* (Pax) Prain	Tree	OB-023	Arched	Anomocytic
7.	*Macaranga barteri* Muell Arg.,	Tree	OB-020	Arched	Paracytic
8.	*Tetrorchidium didymostemon* (Baill) Pax and K. Hoffm.,	Tree	OB-022	Arched	Anomocytic
9.	Order Celastrales Family Icacinaceae *Icacina* mannii Oliv.,	Shrub	OB-02	Arched	Anomocytic
10.	Order Theales Family Ochnaceae *Ouratea affinis* (Hook. F.) Engl.,	Shrub	OB-027	Arched	Paracytic
11.	Order Malphighiales Family Pandanaceae *Microdesmis puberula* Hook. F. ex Planch.	Shrub	OB-05	Arched	Anomocytic
12.	Order *Rubiales* Family *Rubiaceae Massularia acuminata* (G. Don) Bullock ex Hoyle	Shrub	OB-04	Arched	Anomocytic, Paracytic and Diacytic
13.	*Psychotria vogeliana* Benth.,	Shrub	OB-03	Arched	Paracytic
14.	Order Sapindales Family Sapindaceae *Paullinia pinnata* Linn.,	Shrub	OB-010	Arched	Anomocytic
15.	Order Solanales Family Solanaceae *Solanum erianthum* G. Don.,	Shrub	OB-014	Arched	Anomocytic
16.	*S. torvum Sw.*,	Shrub	OB-015	Arched	Anomocytic
17.	Order Malvales (ex Tiliales) Family Malvaceae (ex Tiliaceae) *Glyphaea brevis* (Spreng.) Monachino	Tree	OB-06	Arched	Anisocytic
18	Order Urticales Family Ulmaceae Trema guineensis (Schum and Thonn.) Ficalho	Tree	OB-07	Arched	Paracytic
19.	Order Lamiales Family Verbenaceae *Clerodendron Schweinfurthii* Gurke	Shrub	OB-26	Arched	Anomocytic, Anisocytic and Diacytic Stomata
20.	*C. splendens* G. Don.	Shrub	OB-029	Wavy	Anisocytic and Diacytic

Table 2: Quantitative Stomata Characters of the Woody Species

S/N	Taxon	Stomata Length (µm)	Stomata Breadth (µm)	Pore size (µm)	Stomata Index percentage
1.	Order Apocynales Family Apocynaceae *Tabernaemontana* pachysiphon Stapf.,	34.23	24.55	26.91	15
2.	Order Boraginales Family Boraginaceae *Cordia aurantiaca* Bak.,	29.50	23.25	21.40	24
3.	Order Myrtales Family Combretaceae *Combretum platypterum* (Welw) Hutch and Dalz.,	29.99	22.03	20.64	10
4.	Order Euphorbiales Family Euphorbiaceae *Alchornea cordifolia* (Schum and Thonn.,) Muell. Arg.,	21.88	17.79	16.52	18
5.	*A. laxiflora* (Benth.,) Pax and K. Hoffm.,	25.16	19.66	17.90	14
6.	*Discoglypremna caloneura* (Pax) Prain	27.33	20.35	18.54	8
7.	*Macaranga barteri* Muell Arg.,	30.60	21.96	18.13	4
8.	*Tetrochidium didymostemon* (Baill) Pax and K. Hoffm.,	29.70	19.74	19.86	9
9.	Order Celastrales Family Icacinaceae *Icacina* mannii Oliv.,	23.58	19.57	17.57	22
10.	Order Theales Family Ochnaceae *Ouratea affinis* (Hook. F.) Engl.,	23.08	1632	16.45	17
11.	Order Malphighiales Family Pandaceae *Microdesmis puberula Hook. F. ex Planch.*	20.64	15.88	14.64	17
12.	Order *Rubiales* Family *Rubiaceae* *Massularia acuminata* (G. Don) Bullock ex Hoyle	27.25	21.89	17.15	25
13.	*Psychotria vogeliana* Benth.,	29.43	21.13	20.98	9
14.	Order Sapindales Family Sapindaceae *Paullinia pinnata* Linn.,	23.51	12.70	16.52	18
15.	Order Solanales Family Solanaceae *Solanum erianthum* G. Don.,	27.50	20.74	18.47	19
16.	*S. torvum* Sw.,	18.89	15.96	14.15	14
17.	Order Malvales (ex Tiliales) Family Malvaceae (ex Tiliaceae) *Glyphaea brevis* (Spreng.) Monachino	20.42	16.03	13.44	24
18	Order Urticales Family Ulmaceae Trema guineensis (Schum and Thonn.) Ficalho	19.18	16.03	14.20	15
19.	Order Lamiales Family Verbenaceae *Clerodendron Schweinfurthii* Gurke	24.18	18.54	14.98	16
20.	*C. splendens* G. Don.	26.84	19.76	19.03	0.15

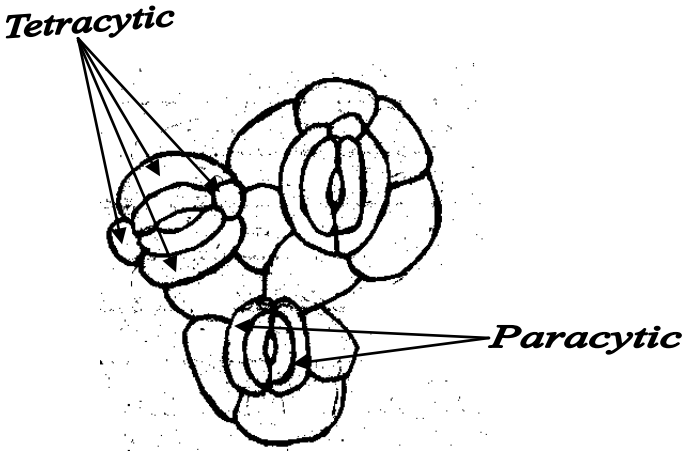

Figure 1: *Tabernaemontana pachysiphon*: Tetracytic and Paracytic Stomata

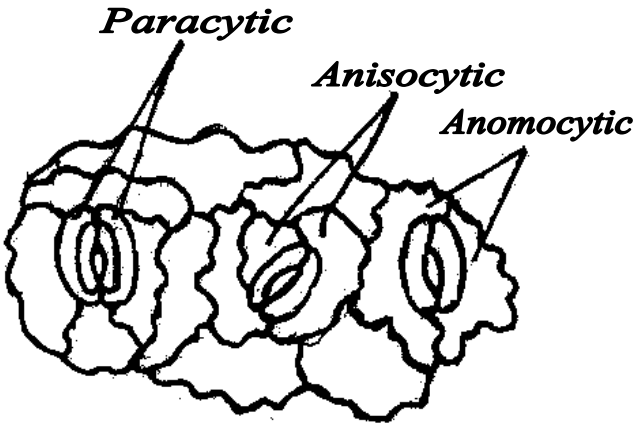

Figure 2: *Cordia aurantiaca*: Anomocytic, Anisocytic and Paracytic Stomata

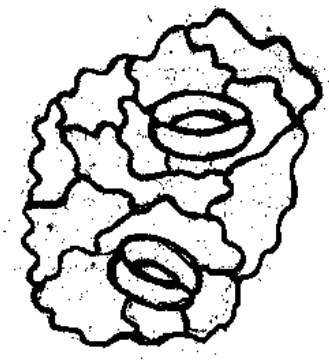

Figure 3: *Combretum platypterum*: Anomocytic Stomata

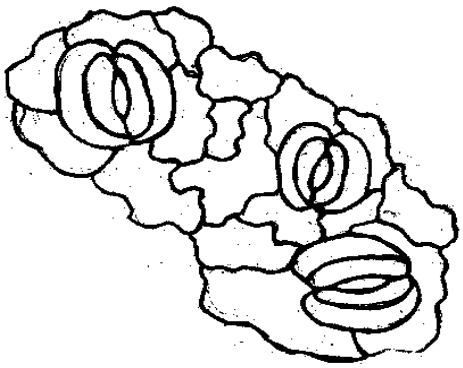

Figure 4: *Alchornea cordifolia*: Paracytic Stomata

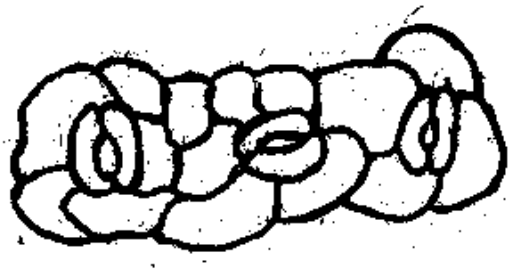

Figure 5: *A. laxiflora*: Anomocytic Stomata

Figure 6: *Discoglypremna caloneura*: Anomocytic stomata

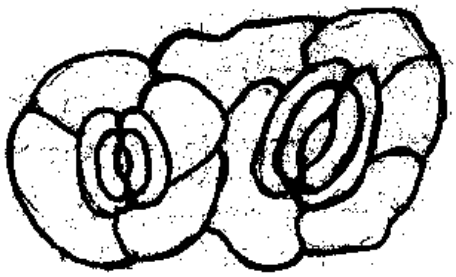

Figure 7: *Macaranga barteri*: Paracytic Stomata

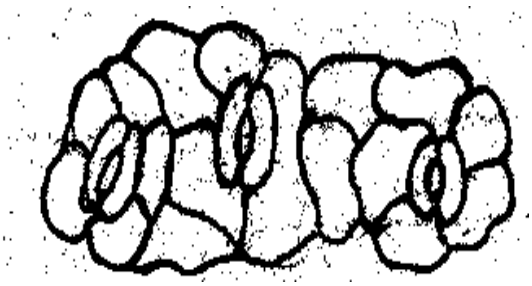

Figure 8: *Tetrorchidium didymostemon*: Anomocytic Stomata

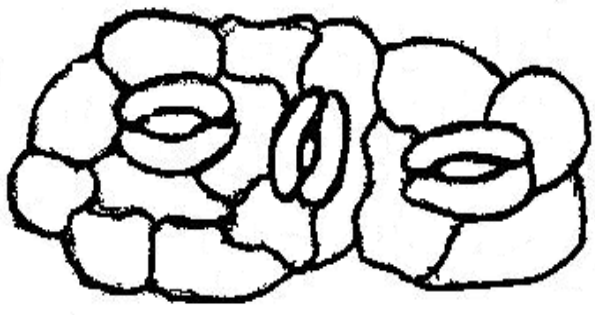

Figure 9: *Icacina mannii*: Anomocytic stomata

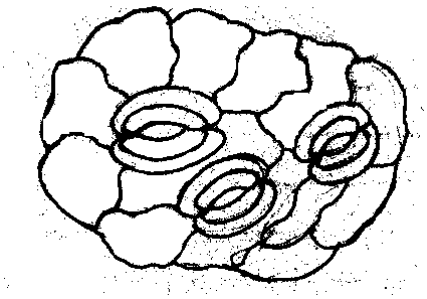

Figure 10: *Quratea affinis*: Paracytic Stomata

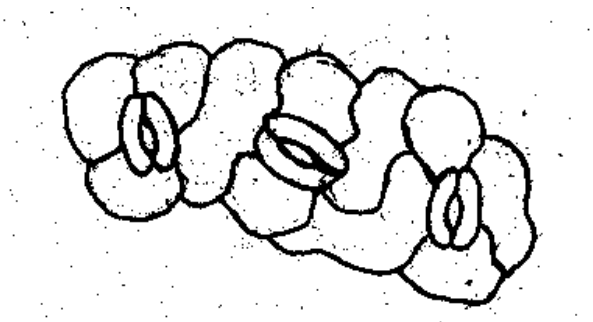

Figure 11: *Microdesmis puberula*: Anomocytic Stomata

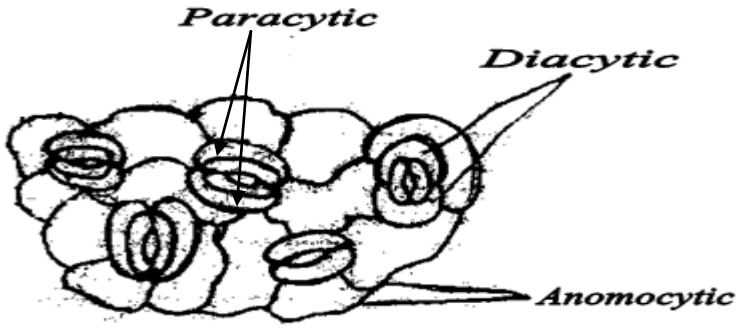

Figure 12: *Massularia acuminata*: Anomocytic, Paracytic and Diacytic stomata

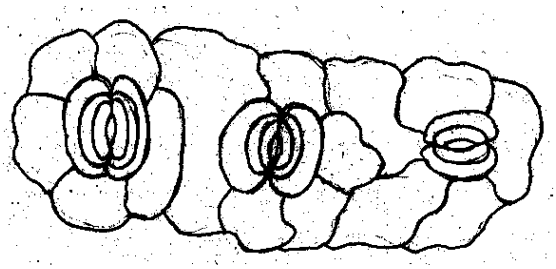

Figure 13: *Psychotria vogeliana*: Paracytic Stomata

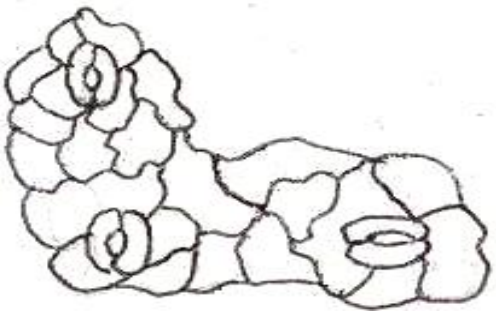

Figure 14: *Paullinia pinnata*: Anomocytic Stomata

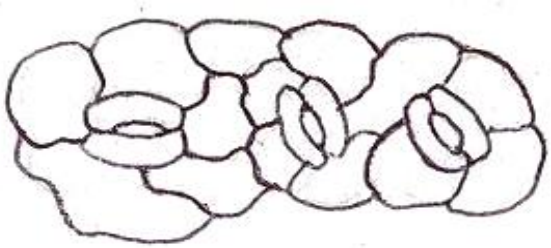

Figure 15: *Solanum erianthum*: Anomocytic stomata

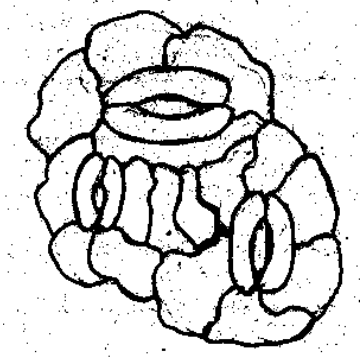

Figure 16: *S. torvum*: Anomocytic Stomata

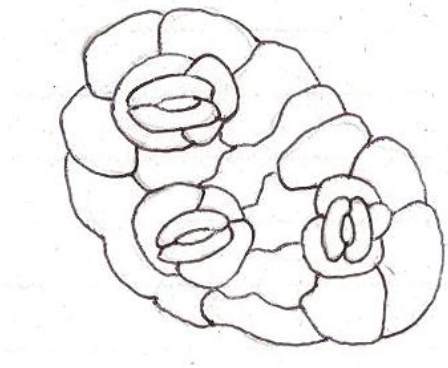

Figure 17: *Glyphaea brevis*: Anisocytic Stomata

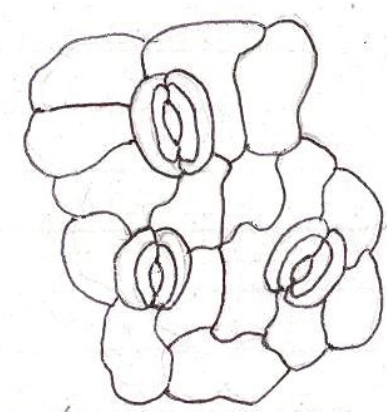

Figure 18: *Trema guineensis*: Paracytic stomata

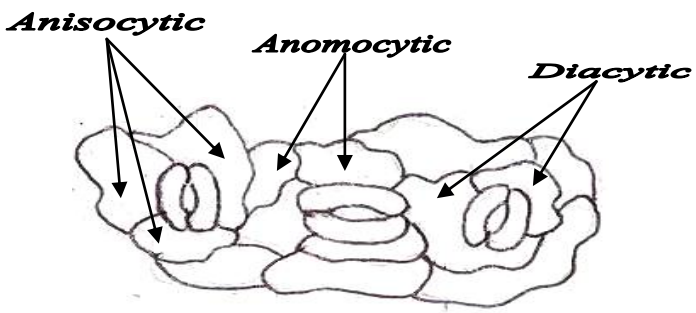

Figure 19: *Clerodenron schweinfurthii*: Anomocytic, Anisocytic and Diacytic Stomata

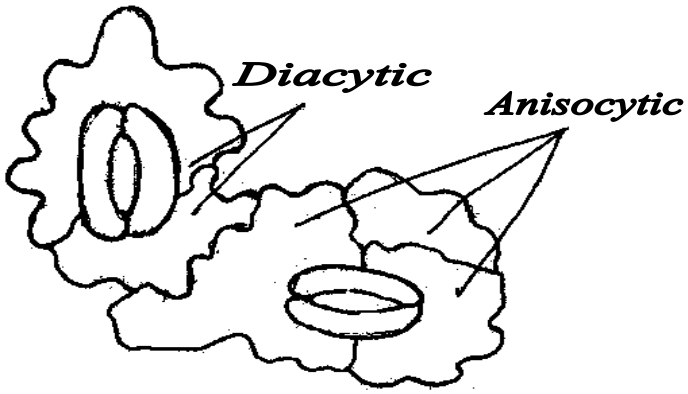

Figure 20: *C. splendens*: Anisocytic and Diacytic Stomata

DISCUSSION

Higher plant anatomical characteristics such as stomatal complex types, stomatal size and index can be used to establish systematic divisions. Stomatal parameters can also be used to suggest phylogenetic relationships in woody taxa and other plant life forms.(Metcalfe and Chalk, 1950a, 1950b, 1979). Stace (1965) states that stomatal size may vary on the same leaf, but this does not prevent it from being used as a taxonomic character in delimiting different species within a genus. Pataky (1969) suggested stomata size of less than 15 um as small and larger ones more than 38µm. Stomata size range of 18.89 x 13.4µm in the shrub *Solanum torvum* to 34.23 x 24.55µm in *Tabernaemontana pachysiphon* a plant of tree habit suggests that woody species in this study have moderate stomatal size.

The role of stomata index in systematic work to delimit species because of it's constancy for any given species has been reported by Cutler (1984) Isawumi (1989), bdulrahamaan and Oladele (2003), Aworinde *et. al,* (2009). Stomata index values varying from 4 in *Macaranga barteri* to 24 in *Glyphaea brevis* were recorded in this study.

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