OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA.

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THAT I MAY KNOW PLANTS: IMPORTANT CHARACTERS IN PLANT IDENTIFICATION AND GROUPING (TAXONOMY)

By

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That I May Know Plants: Important Characters in Plant Identification and Grouping (Taxonomy).

1. INTRODUCTION

The Vice-Chancellor Sir,
The Deputy Vice-Chancellor (Academic),
The Deputy Vice-Chancellor (Administration),
Other Principal Officers of the University – The Registrar, the Bursar and the Librarian,
Provosts (Postgraduate College and the College of Health Sciences),
Deans of all Faculties and the Students Affairs,
Professors and other members of Senate,
Directors,
Heads of Departments/Units,
Distinguished Academics and other Colleagues,
Great OAU Students,
Invited Guests,
Distinguished Ladies and Gentlemen.

"This is the day that the Lord has made; I will rejoice and be glad in it". It is a great privilege for me to stand before you all today to deliver this 335th Inaugural Lecture of the Obafemi Awolowo University, Ile-Ife and the 5th in the Department of Botany. Incidentally, the first four from the Department had been from Plant Ecology and Physiology and this is the first from Plant Taxonomy. I am awed by the grace of God that has kept me thus far, to make this possible. No man can receive anything except he is given from above. I am, therefore, who I am today only by divine mercy and grace. To God alone be all the glory, honour and praises.

My adventure into Botany

Mr. Vice-Chancellor Sir, my adventure into Botany was a true manifestation of the fact that God moves in mysterious ways to perform His purpose. Being the best student in my set in secondary school, St. Teresa's College, Oke-Ado Ibadan, all my teachers concluded I had to go to the University to study Medicine and Surgery and I, unconsciously at first, then later consciously decided that my course in the University would be Medicine and Surgery. One way or another, which is another story on its own, I found myself in Botany. It was not a desired beginning of my path to a career in life, but today, I can say with all certainty that God led me into the path He had chosen for me before the foundation of the earth. Of a truth, the Bible is correct that "all things work together for good, to them that love God" (Romans 8:28).

During my undergraduate studies here in the Department of Botany Obafemi Awolowo University, we were taken through all the areas of specialization in the Department and I actually fell in love with Plant Anatomy and Taxonomy and to some extent, Plant Genetics, because of my love for the microscope. This actually led to my having my undergraduate final year project in Plant Anatomy, my Masters Degree specialization in Plant Anatomy and Taxonomy and later my Ph.D. in Plant Genetics.

Eventually, I fell in love with plants so much that I remember my mother complaining some times when driving her that I was concentrating more on plants in the bush than on the road. Many times I had mentioned to my students in class that plants are the best friends they could have as they could be seen everywhere and students only need to know their names for them to get excited when they see them.

Mr. Vice-Chancellor Sir, distinguished guests, ladies and gentlemen; it is with pleasure and immense gratitude to God that

I stand before you today to deliver this inaugural lecture to render my little contribution to knowledge. Here in the Department of Botany Obafemi Awolowo University, there are five (5) sub-specialties of which my area, Taxonomy with Anatomy and Morphology is one. Other areas are Plant Ecology, Physiology, Genetics and Lower Plants.

In layman's terms, Botany is the study of plants. Plants are man's prime companions in this universe being the source of food and energy, shelter and clothing, drugs and beverages, oxygen and aesthetic environment and as such they have been the dominant component of his taxonomic activity through the ages. The taxonomic (classificatory/grouping) activity of humans is not restricted to living organisms only. Humans learn to identify, describe, name and classify foods, clothes, books, games, vehicles, religions, professions and any other object that they come across or that influence their lives. The process begins and ends with life. Each member of *Homo sapiens* is as such a taxonomist from the cradle to the grave. Classification is thus a natural occupation of man, recognition of one of his most necessary pastimes (Davis and Heywood, 1963; Singh, 2006).

Unlike some fields of modern Botany, Plant Taxonomy has a long history. It gave birth to other phases of Botany but remains exciting, interesting, and important because it deals directly with the fascinating differences among the species of organisms/plants that inhabit the earth. Plant Taxonomy in Greek means "putting in order" or classification. It serves as a major unifying force in Biology, Biochemistry, Comparative Phytochemistry and Electron Microscopy, to develop a framework upon which classifications (groupings) can be developed.

The aims of Taxonomy are: to provide a convenient method of **identification** and communication; to provide a **classification (grouping)** which, as far as possible, expresses the natural

relationships of organisms; to name new plants and to **detect evolution** at work, discovering its processes and interpreting results.

Taxonomic Evidence (Characters for Classification)

Any botanical analysis of a plant necessitates the availability of information about its characteristics. Taxonomic evidence enables better understanding of taxonomic affinities between plants and brings about appropriate identification and grouping of plants. Taxonomic evidence is used for characterization, identification and classification of organisms, populations, and taxa as well as for the determination of phenetic, genetic and phylogenetic relationships.

Taxonomic evidence for the establishment of classifications and phylogenies is gathered from a variety of sources. Because all parts of a plant at all stages of its development can provide taxonomic evidence (characters) important in plant identification and classification (grouping), data must be assembled from diverse sources. The use of information from studies on Comparative Morphology, Physiology, Molecular Biology, Anatomy, Embryology, Palynology, Cytogenetics, Chemistry and so on has greatly improved the modern classification of plants (Figure 1).

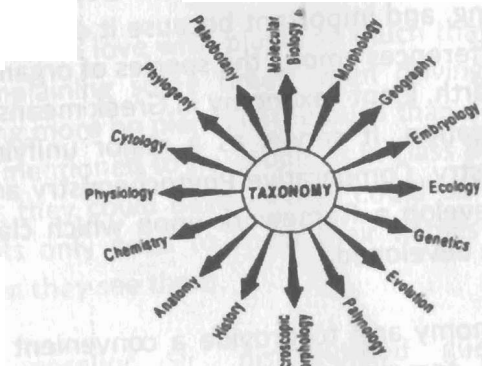


Figure 1: Taxogram showing relationships of various disciplines with plant taxonomy

Mr. Vice-Chancellor Sir, it is in the use of different disciplines of Botany, gathering taxonomic evidences in form of different characters, that I have spent my working career in this University studying, with the aim of documenting important characters for identification and grouping (classification) in the plants I studied, thereby making useful taxonomic deductions not only for Botanical information but also to produce data that could be useful for those in related disciplines such as Pharmacy, Agriculture, etc.

2. MY WORK AND CONTRIBUTIONS TO KNOWLEDGE

MORPHOLOGICAL CHARACTERS IN PLANT TAXONOMY (PHYTOMORPHOLOGY)

Morphology has been the major criterion for classification over many centuries. The initial classifications were based on gross morphological characters. Although floral morphology most especially has been the major concentration for classifications, other morphological characters have also contributed in specific groups of plants.

The taxonomic value of morphological characters has been stressed by several workers, including Hutchinson and Dalziel (1958) in their work titled "Flora of West Tropical Africa" which is like the Bible of plant documentation in West Africa with some morphological descriptions; Terrel and Winters (1974); Jagatheeswari (2014).

We (Adedeji and Illoh, 2005) conducted a morphological study of ten species of the genus *Hibiscus* found in Nigeria. The plant species studied were, *H. lunarifolius* Willd., *H. rostellatus* Guill. & Perr., *H. scotellii* Bak. F., *H. streculiifolius* (Guill. & Perr.) Steud., *H. tiliaceus* Linn., *H. physaloides* Guill. & Perr., *H. acetosella* Welw., *H. sabdariffa* Linn. (the common Isapa), *H. vitifolius* var. *vitifolius* Linn. and *H. surattensis* Linn. This work reported morphological

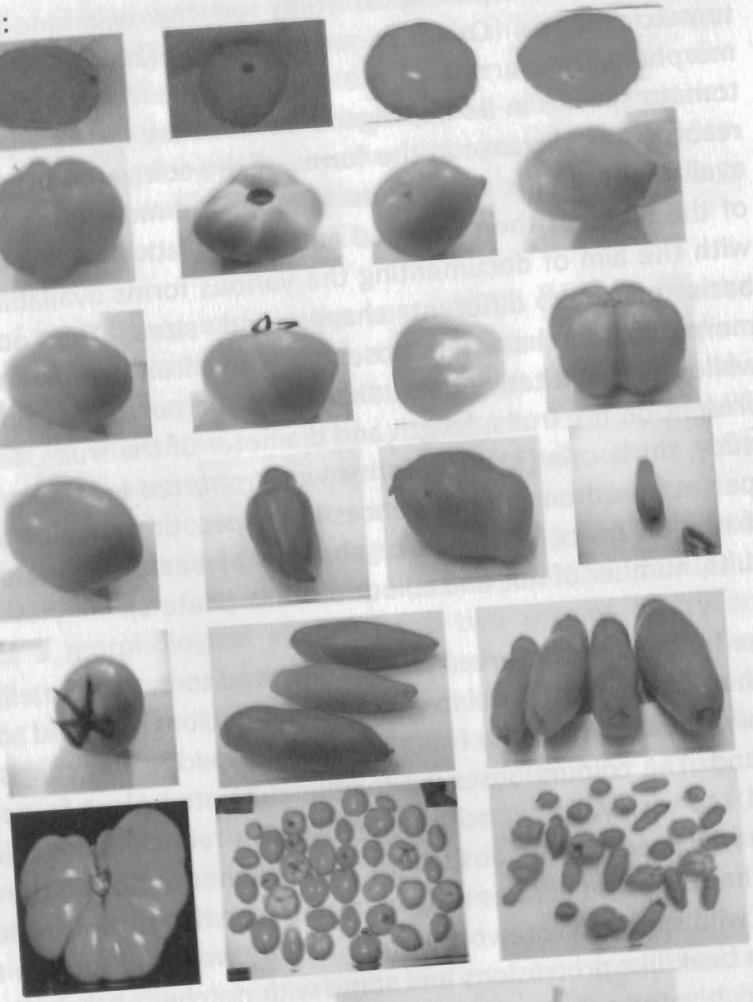
characters of taxonomic value not recorded in the "Flora of West Tropical Africa." These were leaf bases, stipule shape, petal shape, fruit shapes and fruit apices. Habits of the plants were also documented. Eventually, a new key to the *Hibiscus* species, relating and distinguishing the species was provided. Mr. Vice-Chancellor Sir, this was the first known report of the morphology of this array of *Hibiscus* species in Nigeria.

By dint of coincidence early in the year 2002, I came across the wild plant of the cultivated tomato, *Lycopersicon pimpinellifolium* (Jusl.) Mill. whose vegetative growth resembles very closely, the vegetative growth of the cultivated *Lycopersicon esculentum* Mill. tomato plant. I remember showing the plant to a Professor in the Department then who insisted it was the cultivated tomato plant because the vegetative morphology of the wild and cultivated looked very similar. Sequel to this, I (Adedeji, 2005a) decided to conduct a morphological study of the two species to try and identify possible characters that could distinguish them from seedling stage. For the study, the wild species, *Lycopersicon pimpinellifolium* and two cultivars of cultivated tomato were used, *Lycopersicon esculentum* Ibadan local and Roma VF. From my findings, some qualitative characters separate the cultivated from the wild *Lycopersicon*. Leaflet margin is deeply serrated in both cultivars of the cultivated *L. esculentum* while it is entire but occasionally slightly undulating in the wild *L. pimpinellifolium*. The cultivated and the wild can also be distinguished from the leaflet base shape which is oblique in *L. esculentum* cultivars but oblique to entirely cordate in *L. pimpinellifolium*. Number of corolla and calyx range from 5-8 in *L. esculentum* cultivars but is consistently 5 (pentamerous) in *L. pimpinellifolium*. *L. pimpinellifolium* also has the highest fruit number per cluster, 6-15 while it is in the range of 1-5 in the cultivated cultivars. It also has the smallest fruit and seed sizes. Mr. Vice-Chancellor Sir, this was the first known reported work on this wild and cultivated species in Nigeria.

In a further morphological study on the wild and cultivated tomato species, Omotayo and Adedeji (2015), conducted a morphological survey of the fruits of the cultivated and wild tomato species in Ile-Ife, Nigeria because the last few years have recorded an increase in the forms of the cultivated tomato fruits available in Ile-Ife, Osun State Nigeria. The morphological survey of the fruits of the cultivated and wild relatives was carried out with the aim of documenting the various forms available on the basis of their different shapes and sizes. The qualitative morphological characters observed were, fruit colour and shape while the quantitative data taken were the number of ribs/ridges present on the fruits, length and diameter of the fruits. From this study, thirty-one (31) fruit forms were reported for the cultivated species based on the differences in shapes, presence or absence of ribs on fruits, presence or absence of beaks and notches on fruits, number of ribs and colour of fruits (Plate 1).

The fruit shapes observed in the cultivated tomato were ellipsoid, spheroid, obovate, oblate, rhomboidal, elongate, and clavate while the shape for the fruits of the wild species was consistently round. The colours observed for the cultivated plant fruits were red, red with yellow patches and yellowish-red while the colour in the wild species was consistently red. Number of ribs on the fruits of the cultivated species ranged from 0-12 while rib was absent in the wild species. Noteworthy in this study were the tomato fruits with beak-like protrusions and some with notches at the apices of the cultivated species. The length-to-diameter ratio of fruits of the cultivated species was a reliable parameter for differentiating the elongated fruit forms from the other forms in the cultivated species.

Cultivated:



Wild:

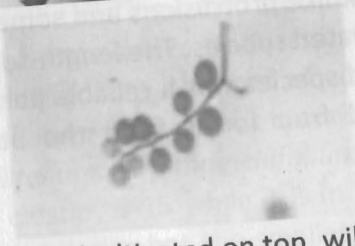


Plate 1: Some tomato fruit shapes (cultivated on top, wild below).

Mr. Vice-Chancellor Sir, one other morphological study that I carried out (Adedeji, 2006) which gave me much excitement and

joy was on the genus *Emilia* Cass. in Nigeria. Hutchinson and Dalziel (1963) had reported three species of *Emilia* Cass. in West Africa and in Nigeria. They were *E. coccinea* (Sims) G. Don, *E. sonchifolia* (Linn.) DC. and *E. praetermissa* Milne-Redhead.

The first active research on the genus *Emilia* in Nigeria was from the work of Olorode and Olorunfemi (1973) with the title "The hybrid origin of *Emilia praetermissa* (Senecioneae: Compositae)" where they reported that *Emilia praetermissa* is an allotetraploid hybrid of *Emilia coccinea* and *Emilia sonchifolia*. As at the time of Hutchinson and Dalziel's documentation, nothing was known about their ploidy levels. The report and classification of these three species by Hutchinson and Dalziel were based largely on few morphological characters: height of the plants, upper leaf shape, number of involucral bracts and floret colour. In my morphological study of the genus (Plate 2), other additional characters were discovered to be important for the taxonomy of the genus. These included the bloom colour, colour and pubescence of the stem, differences in the margin of the leaves, pedicel length, capitulum length and breadth, corolla tube, style and stigma colours, floret number, fruit number and size. It was also observed in the study that the habitat preferences of *Emilia sonchifolia* and *E. coccinea,* the diploid parents of *E. praetermissa* differ. While *E. sonchifolia* thrives in direct open sunlight and dry well-drained soil, *E. coccinea* prefers moist to slightly wet soil and partial shade. *E. praetermissa*, the allotetraploid hybrid on the other hand, thrives in both types of habitats of its diploid parents.

Plate 2: Habit of the two parents (*Emilia sonchifolia* and *Emilia coccinea*, on top) and their hybrid (*Emilia praetermissa*, below).

According to Swanson (1968), it is the great ecological amplitude of polyploid species that gives them a high degree of buffering against environmental changes and enables them to tolerate wide environmental ranges. Moreover, many individual polyploid genotypes have phenotypes which are able to tolerate a wide range of environmental conditions: they are 'general purpose genotypes.' In this study of habitat preferences, *E. praetermissa* behaves like a true allopolyploid as "allopolyploids will generally exhibit a mingling of the parental characteristics" (Swanson, 1968). In stem characteristics, leaf margin characteristics, the allotetraploid hybrid is closer to *E. sonchifolia* parent more than *E. coccinea* parent. A taxonomic key showing the relationship of the three species to one another was constructed based on the characters studied.

In the work titled "Morphological, Agrobotanical and Reproductive Studies in 35 accessions of *Panicum maximum* Jacq. in South Western Nigeria" Adedeji and Faluyi (2006) reported that *Panicum maximum* commonly called guinea grass, occur in two distinct field forms in Southwestern Nigeria: the open, tall, relatively fat culms with long and broad leaves and the open, not so tall, culm diameter comparatively thin with not so long and narrow leaves (Plates 3 and 4).

Plate 3: The researcher with *Panicum maximum* Jacq. plant on the field.

Plate 4: Two field forms in *Panicum maximum*

These two distinct morphological forms were initially thought to be different ploidy levels. But after collecting and planting them in the same environmental condition, it was observed that they reverted to almost the same morphological form showing that the initial observation of their forms in their natural habitats was more environmental than genetic.

Odu *et al.* (2006), I inclusive, conducted morphological study on the genus *Carica* in the work titled "Occurrence of hermaphroditic plants of *Carica papaya* L. (Caricaceae) in Southwestern Nigeria." The study was on the three sex types of *Carica papaya* L. (pawpaw), a mono-species in the genus *Carica in* Nigeria, in order to elucidate the floral differences of the sex types and compare the germination ability of the seeds. The work established three sex types, female, male and hermaphrodite for this plant in Nigeria. Floral characters reported to be taxonomically important in delimiting the three sex types include type of inflorescence, petal size, presence or absence and size of corolla tube, size of ovary and fruit shape. The work reported sexual dimorphism in petal size in *Carica papaya*. Female petals are generally larger than the male and hermaphroditic petals (Plate 5).

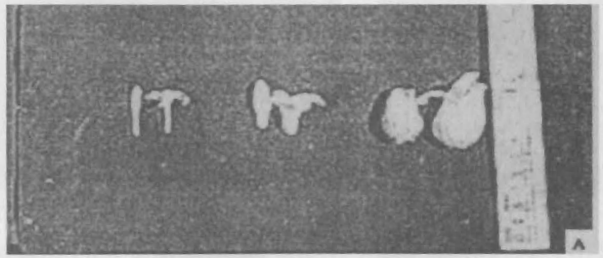


Plate 5: Variations in the flower of *Carica papaya* plant forms (Male flowers – on the left; Hermaphroditic flowers – in the middle; Female flowers – on the right).

Female flowers are more or less polypetalous while male and hermaphroditic flowers are gamopetalous forming a corolla tube from the base of which the ovaries (whether rudimentary or not), arise. The absence of a corolla tube on the one hand, conveniently differentiates the female flower from the male and hermaphroditic flowers (Plate 5). On the other hand, the size of the corolla tube can be used to delimit the staminate flower from a truly male plant and staminate flower from the hermaphroditic plant, the tube being long and narrow in the typical male but

short and broad in the staminate flowers from hermaphroditic plants (Plate 5). All male flowers and almost all hermaphroditic flowers examined had rudimentary ovaries while the female unisexual flowers had bigger and functional ovaries.

Fruit shape in the female plant is largely spherical, occasionally elongated, whereas fruits from hermaphrodites exhibit diverse shapes. That fruit form is under genetic control is made apparent in Plate 6where an hermaphrodite and a female *Carica* tree are growing and fruiting under similar environmental conditions but displaying clearly distinct fruit shapes.

Among the fruiting forms, the seeds from female plants germinate faster and have a higher germination index than the seeds from hermaphroditic plants. This was the first known comprehensive report on the floral differences of the three sex types of *Carica papaya* in Nigeria. It was also the first known formal report of the variations in fruit shape in the hermaphrodite *Carica papaya* sex type occurring in Nigeria.

Plate 6: Habit and fruit forms of *Carica papaya* L. – A: hermaphroditic plant (in front with 2 elongated fruits, a female plant partly showing at the back); B: Hermaphroditic (on the left) and Female (on the right); C: Female plant (with spherical-shaped fruits); D: Hermaphroditic plant (with elongated fruits).

In a recent work, Owolabi and Adedeji (2016), studied the morphology of ten species in the subfamily Papilionoideae with the view to documenting diagnostic characters of taxonomic value. The species studied belong to four tribes namely: ***tribe Desmodieae*** – *Desmodium tortuosum* (Sw.) DC., *Desmodium scorpiurus* (Sw.) Desv., *Desmodium adscendens* (Sw.) DC., **tribe Phaseoleae** – *Cajanus cajan* (L.) Millsp., *Calopogonium mucunoides* Desv., *Centrosema molle* (Mart.) ex. Benth., *Mucuna pruriens* (Linn.) Walp. (werepe in Yoruba language, with spiky hairs on the mature bean pods that are very irritating to the skin, Plate 7), *Vigna unguiculata* (Linn.) Walp., **tribe Crotalarieae** – *Crotalaria retusa* Linn., **tribe Robinieae** – *Gliricidia sepium* (Jacq.) Walp. (igi agunmaniye, in Yoruba language, Plate 8).

Qualitative and quantitative characters which had not been documented in previous works, especially in Nigeria, were studied and documented. These included leaf/leaflet apex, base, margin and pubescence; stem type, colour, shape and pubescence; sepal colour and pubescence; nature of margin of petal standard and presence or absence of pedicel; fruit colour, pubescence, tip and shape; seed colour, shape, surface and presence or absence of prominent hilum on the seed; number of seeds per fruit; pedicel length; length and width of petal standard, keel and wing. The important characters that could be used in establishing the taxonomic relationship in the sub-family Papilionoideae were identified as leaf type, leaf shape, leaf base, petiole type, stem shape, petal colour, petal margin and seed shape.

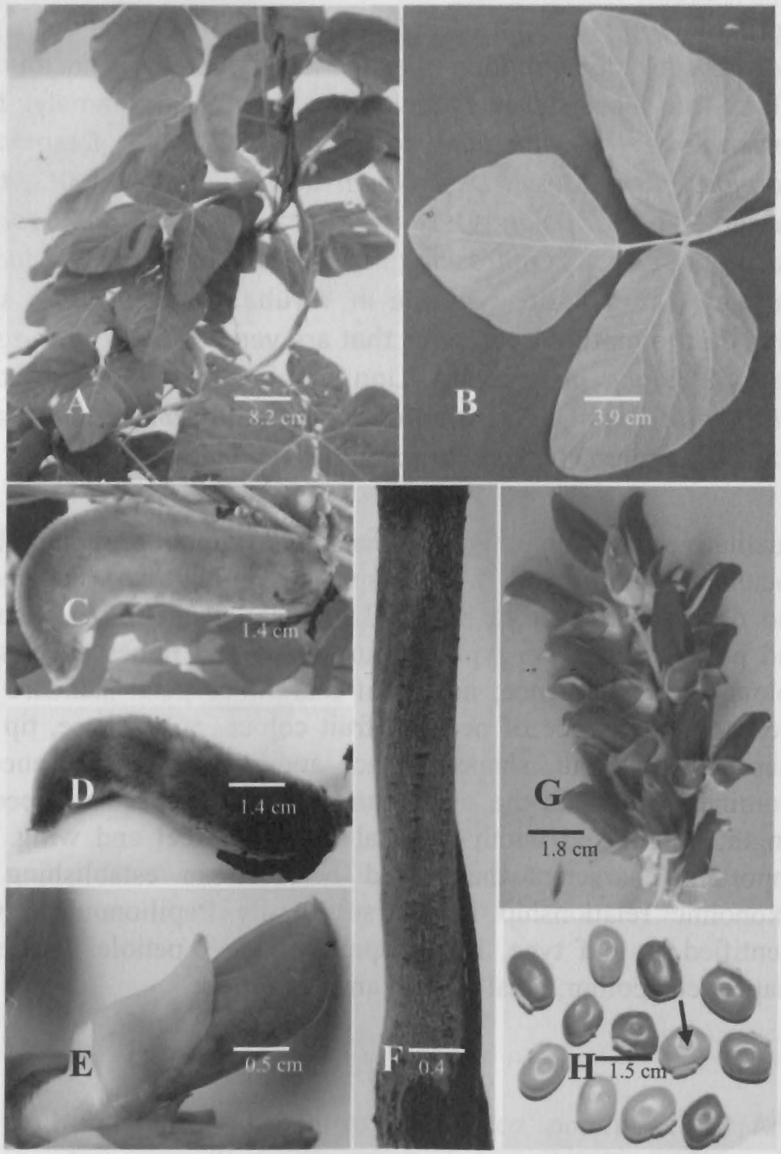


Plate 7: Morphology of *Mucuna pruriens* (werepe). A – Habit (herbaceous twinner); B-Leaf; C & D – Fruits; E – Flower; F – Stem; G –Inflorescence; H –Seeds (arrow points at depression)

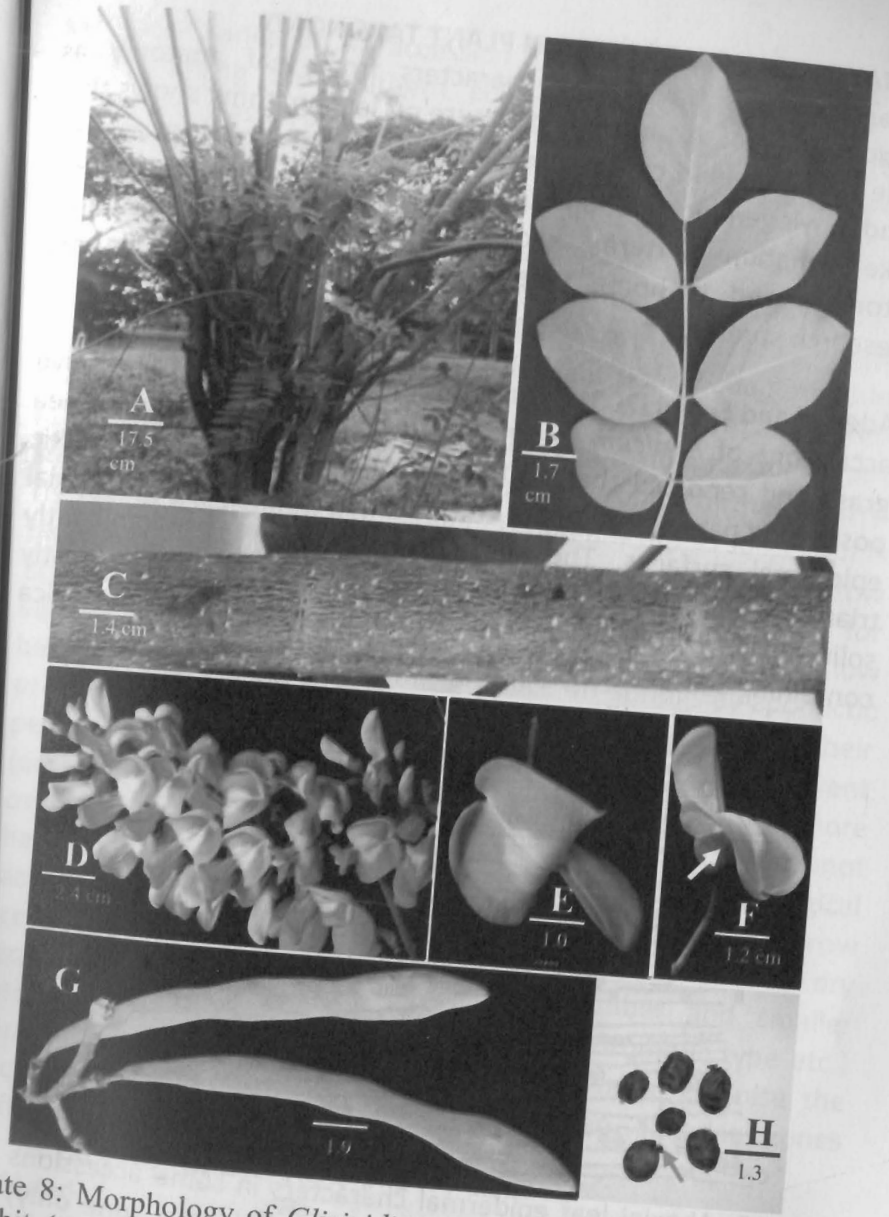


Plate 8: Morphology of *Gliricidia sepium* (igi agunmaniye), A – Habit (tree); B – Leaf; C – Stem; D – Inflorescence; E & F – Flower (arrow pointing at calyx); G – Fruits (fresh); H – Seeds (arrow pointing at prominent hilum).

ANATOMICAL CHARACTERS IN PLANT TAXONOMY

Many authors have used characters from leaf anatomy as taxonomic tool. A survey of literature on leaf anatomy shows that the data obtained can be used for the clarification of taxonomic and phylogenetic relationships. The commonly used characters like venation patterns and epidermal structures (including stomata and trichome types) were largely employed in my research studies.

Adedeji and Faluyi (2001), studied the foliar anatomy of thirty-five accessions of *Panicum maximum* Jacq. commonly called guinea grass and reported that all the accessions were amphistomatic possessing paracytic stomata type on both the adaxial and abaxial epidermal surfaces. The subsidiary cells were predominantly triangular in shape. The intercostal short cells were mostly solitary, occasionally paired, often associated with silica containing cells. Prickle hair and micro hair were also reported.

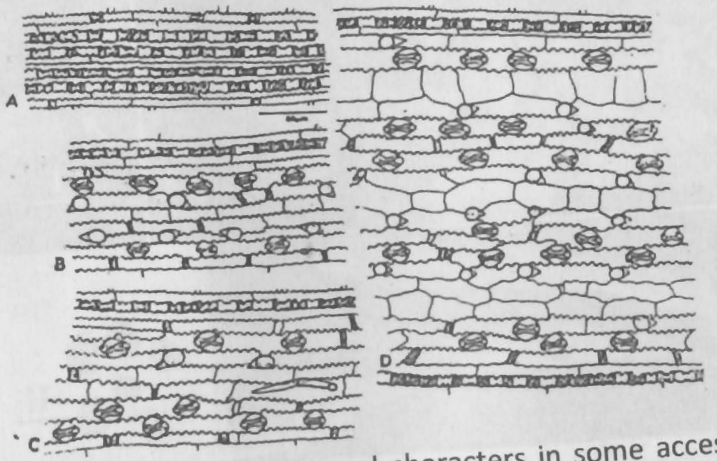


Plate 9: Abaxial leaf epidermal characters in some accessions of *Panicum maximum*, A – Abaxial epidermis (costal zone only) accession 34; B – Intercostal zone of abaxial epidermis accession 32; C – Intercostal zone of abaxial epidermis accession 34; D – Wider intercostal zone of abaxial epidermis accession 35.

Mr. Vice-Chancellor Sir, accession 35 collected from a transition zone marking the southern end of major distribution of *P. maximum* was reported to be unique in having the biggest stomata size and 3-4 bands of stomata on the intercostal zones (Plate 9).

The occurrence of bigger and higher number of stomata in this accession 35 would certainly lead to increased evapo-transpiration which would make this plant poorly adapted to an ecological regime where there is more insolation, diminished rainfall and longer dry season as we have in the Sahel, Guinea and Sudan Savanna zones (that is, the northern zones) of the country. The observation about *P. maximum* is that it is not as successful in these zones as in the lowland. In a critical sense, they have narrow ecological amplitude. The prognosis is that the potential for variability in the populations of *P. maximum* studied is very low because it does not set seed nor produce off-springs by apomictic processes. They rely entirely on vegetative means for their perennation and spread and do so with great success. If this event (occurrence of bigger and more stomata) is a response to more oxygen from the environment, it is a faulty response and it cannot have an adaptive value. It is probable that the narrow ecological amplitude of *P. maximum* is a direct reflection of its narrow genetic base. Lack of genetic resources to survive in a dry ecological zone (ability to have lower number and smaller stomata, reduced leaf surface, revert to hypostomatic type etc.) probably explains the inability of *P. maximum* to colonise the ecologies of the Sahel, Guinea and Sudan Savanna zones effectively.

(Adedeji, 2004) conducted a taxonomic study on the genus *Emilia* Cass. in Nigeria in search of useful and stable anatomical characters for the classification of the three species in West Africa and Nigeria. Stomata type and index indicate that *Emilia praetermissa* is a hybrid between *E. coccinea* and *E. sonchifolia.*

Larger cell size in all studied size attributes supports *E. praetermissa* as an allotetraploid hybrid. Trichome (hairs on plants) type (Plates 11A, B&D; 12B-D), stomata type, stomata shape and size attributes were all characters of *E. sonchifolia* and *E. praetermissa* that were consistently close in resemblance and values to suggest *E. sonchifolia* as the closer parent of *E. praetermissa* exerting gene dominance. This would also suggest introgression between *E. sonchifolia* and *E. praetermissa*. Mr. Vice-Chancellor Sir, this was a novel report on the genus in Nigeria.

The foliar anatomy of ten species of the genus *Hibiscus* (excluding the commonly known exotic species) in Nigeria was described by Adedeji and Illoh (2004). This was the first known comprehensive report of the foliar anatomy of the genus in Nigeria. The distinguishing characters of taxonomic value reported were variation in the shapes of petioles in the proximal region, variation in the number and arrangement of the vascular bundles, presence or absence of medullary bundles in the pith at the distal end of the petiole through transverse sections (Plate 10), types of trichomes on the lamina and petioles and presence or absence of cuticular striations on the epidermal surfaces.

Druses of calcium oxalate crystals occurred generally in the genus however, occurrence, distribution and quantity of these crystals were quite diagnostic on the adaxial and abaxial epidermal surfaces of *H. rostellatus* (Plate 11C). Palmate venation with the primary veins generally radiating from a single point at the base was reported for all the species. Ramification of the lateral actinodromous vein was generally perfect reticulate. Number of veinlet endings was in the range of 0-5. Mucilaginous cells which were usually bigger than the surrounding epidermal cells and staining differently from the other epidermal cells were documented in the species studied (Plate 11A).

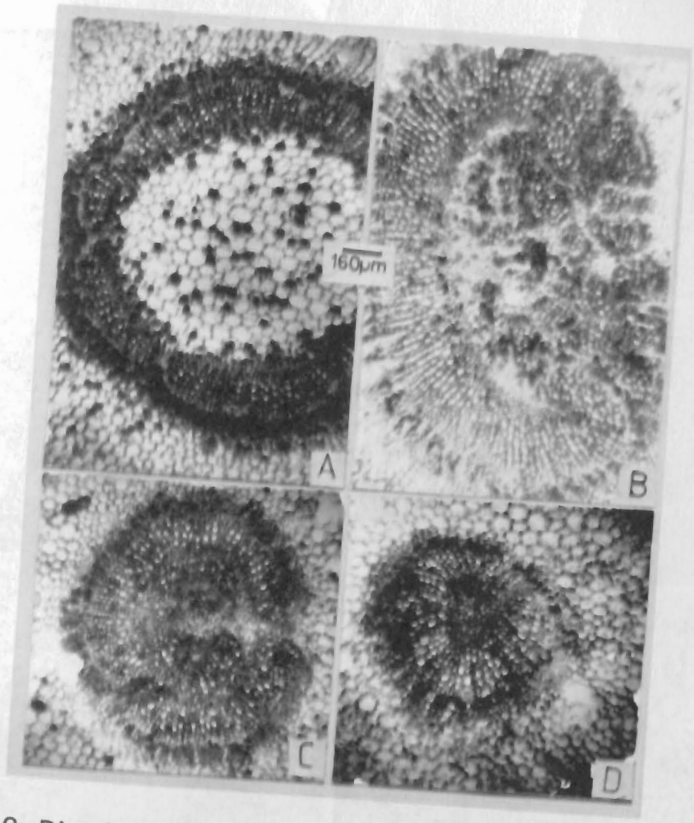


Plate 10: Distal region of the petiole showing the pith: A – pith without medullary bundle; B – pith with medullary bundle in *Hibiscus rostellatus*; C – pith with medullary bundle in *H. scotellii* and *H. tiliaceus*; D – pith with medullary bundle in *H. acetosella*.

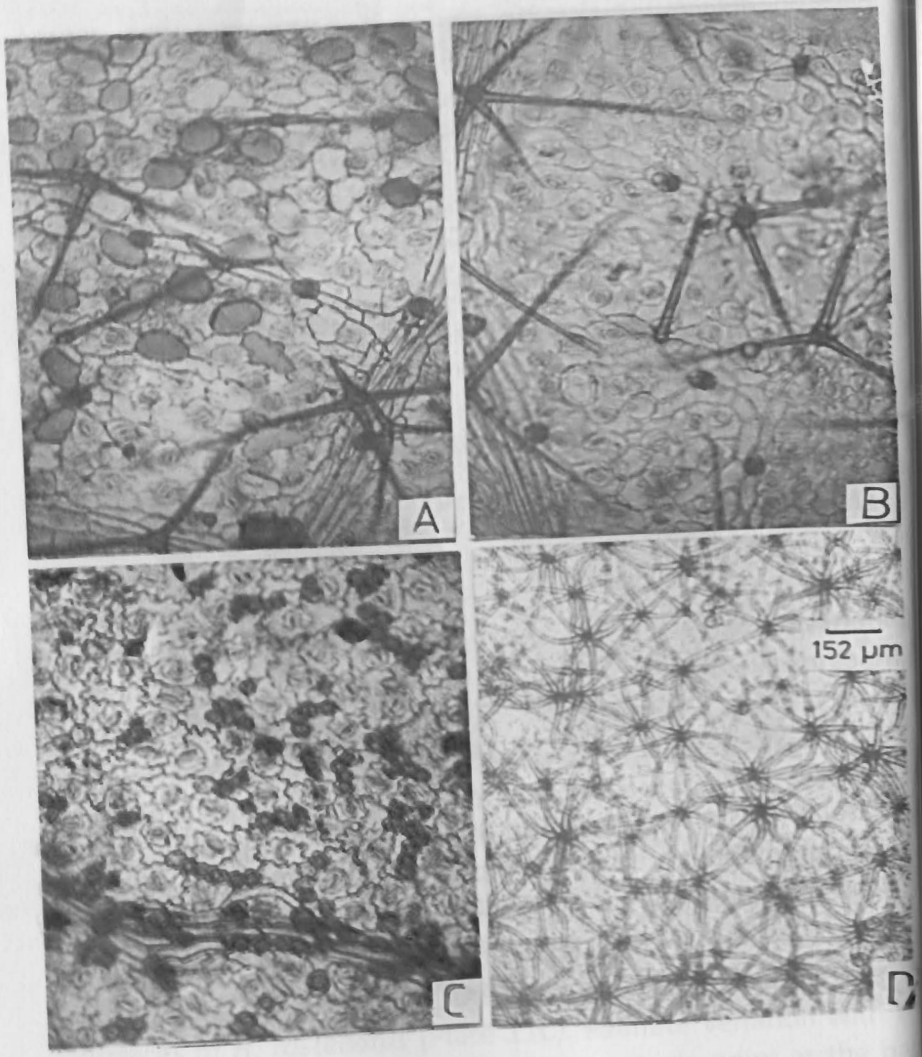


Plate 11: Leaf epidermal surfaces in the genus *Hibiscus*, A - Epidermal cells with mucilaginous cells staining deeper; B & D – Epidermal cells with non-glandular trichomes; C – Epidermal cells with druses staining dark grey.

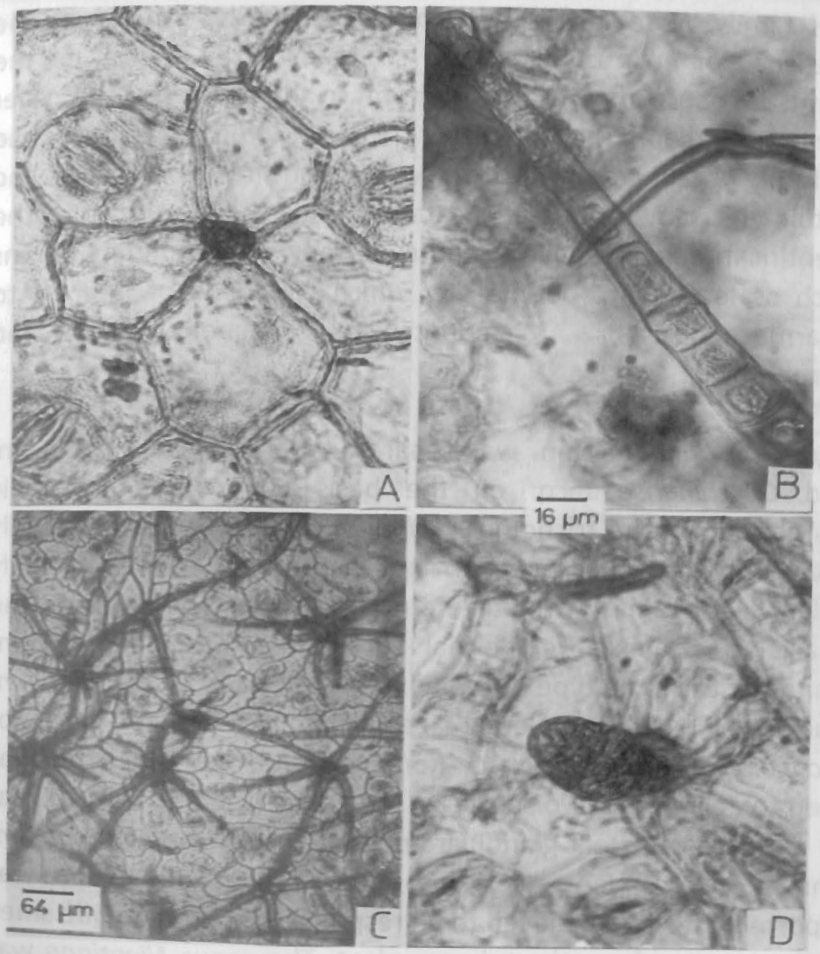


Plate 12: Leaf epidermal surfaces in the genus *Hibiscus*: A – Trichome base with surrounding cells; B & C – Non-glandular trichomes (B: Uniseriate, C: Stellate); D – Glandular trichome

The leaf epidermal and organographic distribution of trichomes (hairs) studies were carried out on nine species in four genera in the family Solanaceae (Adedeji *et al.*, 2007). There had been very sparse report on the foliar epidermal anatomy of the family

Solanaceae. This study aimed at redressing the knowledge gap in this family. Noteworthy from the report of this study was the presence of protrusions on the stomata of the species in the genus *Lycopersicon* which was absent in the species of the other genera studied. The different trichome types observed had differing organographic distributions within the same species and within the same genus in the family. This can be useful in the identification of the species and even their corresponding organs such as leaf, stem, petiole etc. which would be of interest to Pharmacognosists, Archaeobotanists, Palaeobotanists and Agronomists.

Capsicum annuum Linn. was separated from *C. frutescens* Linn. and *C. chinense* Jacq. on the basis of the organographic distribution of the trichomes. *Solanum torvum* Sw. was the only species in the genus *Solanum* and in the species of the family Solanaceae studied with stellate non-glandular trichomes on the adaxial and abaxial epidermal surfaces. The spine-like, non-glandular trichome type observed in *Lycopersicon pimpinellifolium* (Jusl.) Mill. was completely absent in all the plant parts of *Lycopersicon lycopersicum* cv Roma VF Linn. This character was used to delimit the two species in the genus. The unique bicellular to multicellular stalk glandular trichomes of *Nicotiana tabacum* Linn. (tobacco plant), a mono-species genus in Nigeria was reported. They are believed to be responsible for the unique smell that emanates from the tobacco plant. The genus *Nicotiana* was the only genus out of the four genera in the family studied, with multicellular stalk glandular trichomes.

Adedeji and Jewoola (2008) also reported the usefulness of trichomes in the taxonomy of the family Asteraceae (Plate 13).

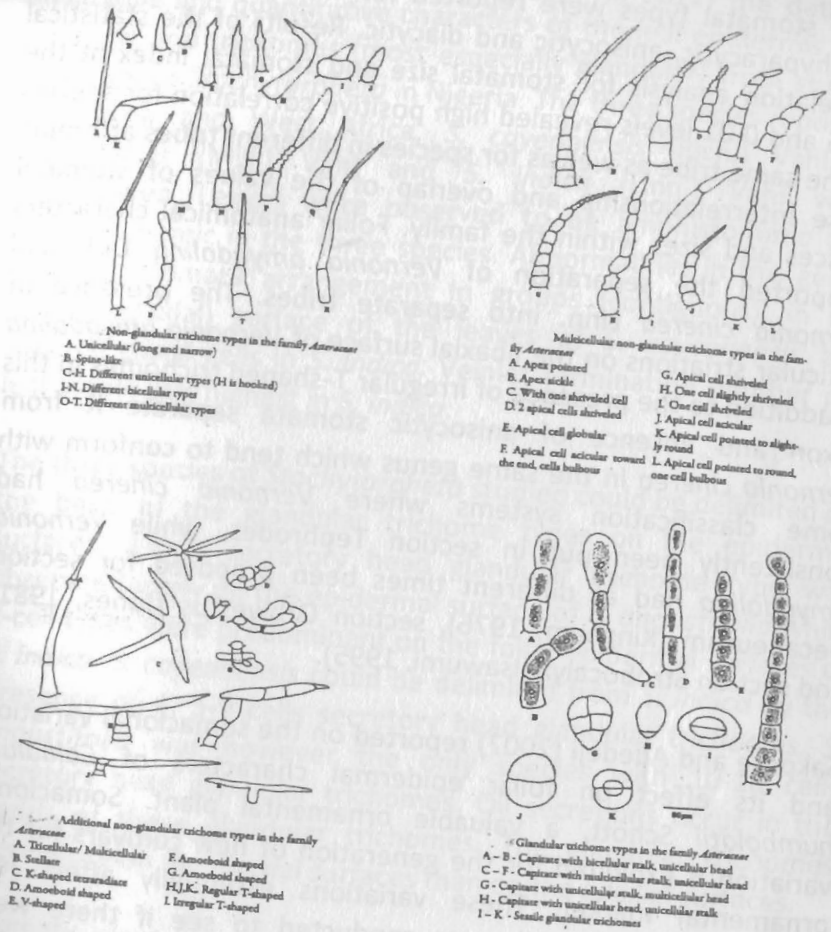


Plate 13: Trichomes in the family Asteraceae.

Within each species of the twelve species studied, there was varied assortment of trichomes with occasional transitions among them. Stellate trichome type and K-shaped or tetraradiate trichomes were observed in *Tridax procumbens* Linn. only while the genus *Vernonia* could be delimited from the other genera by the possession of T-shaped trichomes which were absent in the other genera while amoeboid-shaped trichomes could be found in the genus *Chromolaena* only.

Four stomatal types were reported for the family: anomocytic, brachyparacytic, anisocytic and diacytic. Results of the statistical correlation analysis for stomatal size and stomatal index at the 0.05 and 0.01 levels revealed high positive correlation for species in the same tribe as well as for species in different tribes affirming close interrelationship and overlap of the values of stomatal indices and sizes within the family. Foliar anatomical characters supported the separation of *Vernonia amygdalina* Del. and *Vernonia cinerea* Linn. into separate tribes. The presence of cuticular striations on the abaxial surface of *Vernonia amygdalina* in addition to the presence of irregular T-shaped trichomes in this taxon and absence of anisocytic stomata separate it from *Vernonia cinerea* in the same genus which tend to conform with some classification systems where *Vernonia cinerea* had consistently been put in section Tephrodes, while *Vernonia amygdalina* had at different times been proposed for section Decaneurum (Kingham, 1976), section Orbivestus (Jones, 1981) and section Strobocalyx (Isawumi, 1995).

Sakpere and Adedeji (2007) reported on the somaclonal variation and its effect on foliar epidermal characters of *Caladium humboldtii* Schott, a valuable ornamental plant. Somaclonal variation is exploited for the generation of new cultivars for the ornamental market. These variations essentially affect leaf morphology. This study was conducted to see if there were corresponding anatomical differences by comparing the foliar anatomy of the parent plant, *Caladium humboldtii* Schott and its somaclonal variant, *C. humboldtii* 'Sakpere' derived from tuber explants cultured on full strength Murashige & Skoog's medium supplemented with 3% (w/v) sucrose and 0.4 mg/L 2.4-D combined with 1.0 mg/L kinetin. Foliar epidermal studies revealed significant differences in size of epidermal cells, stomatal index and stomatal size of the parent plant and the somaclonal variant. Circular shaped stomata were encountered in *C. humboldtii* 'Schott' which were sparse to absent in *C. humboldtii* 'Sakpere'.

Mr. Vice Chancellor sir, I reported (Adedeji, 2012) the detailed qualitative and quantitative characters of the leaf epidermis, leaf venation and trichomes (most especially glandular) from studies in the genus *Stachytarpheta* in Nigeria. The three species reported in Nigeria and West Africa, *S. cayennensis* (Rich.) Vahl, *S. angustifolia* (Mill.) Vahl and *S. indica* (Linn.) Vahl were investigated. Leaves were observed to be amphistomatic and amphitrichomic in the three species. Abnormalities in this genus included stomata arrangement in groups (contiguous), in the upper (adaxial) surface of the leaves of *S. cayennensis* and aborted guard cells in *S. indica.* Veinlet termination number per leaf areole was highest in *S. indica*.

The three species of *Stachytarpheta* studied could be delimited on the basis of the glandular trichome types on the epidermal surfaces. 4-cells secretory head glandular trichome type was observed largely on the epidermal surface of *S. angustifolia* while 2-cell types were predominant on the foliar epidermal surfaces of *S. indica*. *S. cayennensis* could be delimited from *S. indica* by the presence of 4, 5-9 cells secretory head glandular trichomes. *S. angustifolia* was however the only species with 10-16 cells secretory head glandular trichomes. Oil secretions occur in the glands of these glandular trichomes. The glandular trichomes were more on the abaxial surfaces than on the adaxial surfaces.

Aromatic plants grow in sunny environments and the trichomes, being protected in the abaxial surface, allow the secretions to remain for an extended time in the plant. Judd *et al.* (1999) had reported the presence of glandular trichomes secreting essential oils in the family Verbenaceae. These oils normally evaporate and are released under high temperature and low humidity; hence their preponderance on the abaxial surface is largely for protection. *S. angustifolia* is the species out of the three, with the highest frequency of glandular trichomes, occurring more on the abaxial surface. This is quite diagnostic for this species, suggesting

its ability for secretion and retention of these essential oils more than in the other two species. The glandular trichomes also present ecological significance, being associated with the plant's interaction with the environment, interfering efficiently against the attack of herbivores and pathogens (Marquis, 1992). The long-stalked secretory head glandular trichome type was observed to be unique to the petal tube in the three species. Crystals of different sizes and shapes were observed in the various plant parts in the three species of *Stachytarpheta* studied occurring singly when big and in groups when small.

Mr. Vice Chancellor Sir, my distinguished audience, Cyperaceae is a family of monocotyledonous graminoid flowering plants known as sedges which superficially resemble grasses. Odedeji and Adedeji (2015) studied the foliar epidermal characters in this family of monocotyledons. *Rhychospora corymbosa* (Linn.) Britton was distinctly separated from the other species studied because it was the only hypostomatic species while the others were amphistomatic. It was the only species with 1-5 rows of stomata per band and it had the highest stomata number. The distinct foliar epidermal separation of *R. corymbosa* validated its placement in the tribe Schoeneae. Big sized circular papillae on the intercostal zones of *Cyperus haspan* Linn. delimited it from all the other species studied. Out of the three *Kyllinga* species studied, idioblast was observed on both abaxial and adaxial surfaces of *K. erecta* Schumacher. and *K. pumila* Michx. but absent in *K. nemoralis* (Forst.) Dandy ex Hutch. Further foliar anatomical works on different plant taxa were reported by Arogundade and Adedeji (2016, 2017, 2019) and Owolabi and Adedeji (2018).

Characters of the stem such as rays, vessels, fibres etc. have been documented to be of taxonomic value (Aguoru and Okoli, 2012, El-Chamery *et al.*, 2017). According to Dickison (2000), the secondary xylem has proved to be highly significant in elucidating higher level plant phylogenies. In no other vegetative tissues are

the trends of structural evolution as clearly defined. Adedeji and Owolabi (2018), in our work on the stem anatomy of ten members of the subfamily Papilionoideae, reported that vessel length and diameter characters in the subfamily Papilionoideae suggest primitiveness of the vessels in *Vigna unguiculata* (Linn.) Walp. while they are more advanced in *Mucuna pruriens* (Linn.) Walp. Among the three species of *Desmodium* studied, *Desmodium scorpiurus* (Sw.) Desv. seems to be more advanced and *Desmodium tortuosum* (Sw.) DC. least advanced in stem characters. Below are photographs of stem anatomical characters in four of the species studied (Plates 14-17)

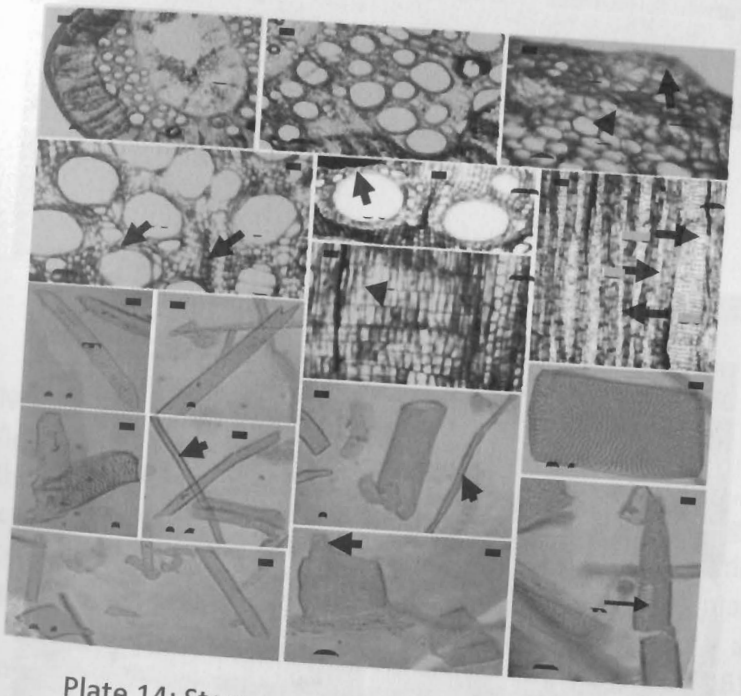


Plate 14: Stem anatomy of *Vigna unguiculata*

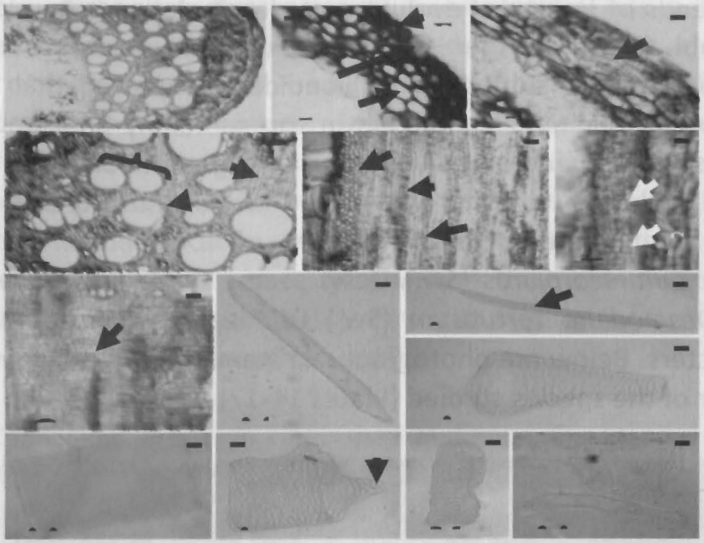


Plate 15: Stem anatomy of *Mucuna pruriens*

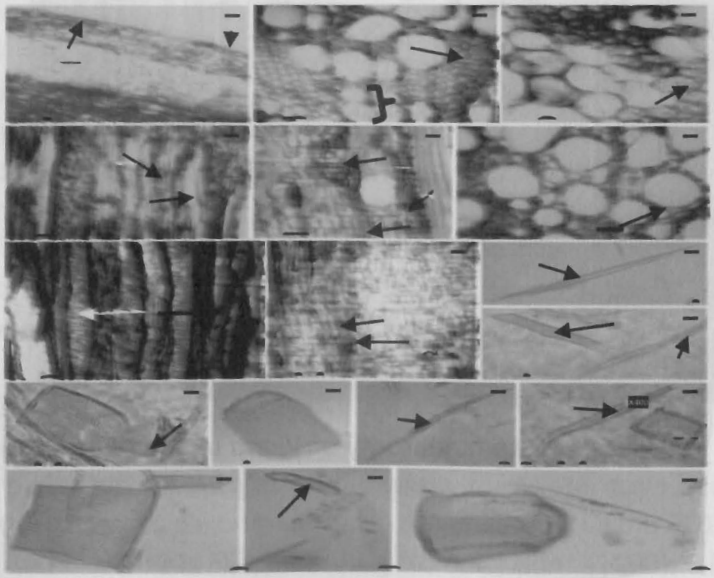


Plate 16: Stem anatomy of *Desmodium scorpiurus*

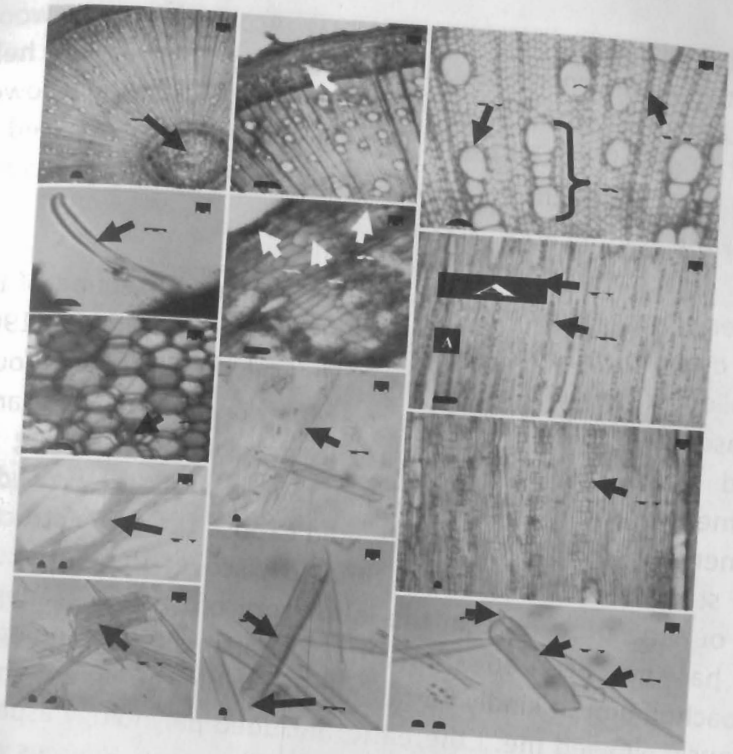


Plate 17: Stem anatomy of *Desmodium tortuosum*

PALYNOLOGY IN PLANT TAXONOMY

Mr. Vice-Chancellor Sir, Distinguished Ladies and Gentlemen, my contributions to the frontier of Taxonomy using Palynological characters commenced during my M.Sc postgraduate studies. Palynology is the study of pollen grains produced by seed plants and spores produced by Pteridophytes, Bryophytes, Algae and Fungi. I was taking a postgraduate course then, BOT 610: Experimental Methods in Taxonomy, taught by Prof. Isawumi, a Botanist who retired from the Natural History Museum of this University. One of the experimental methods he taught us was Palynology. I got interested in this area, more because of the reliability and stability of the characters obtained from pollen grains. Characters of the pollen provide one of the best taxonomic criteria, being often constant, not very variable and easily visible

under the microscope (Sivarajan, 1991). According to Heywood (1978), the exine ornamentation patterns have been a great help in the identification and delimitation of taxa, especially at lower levels. The details of the exine are such that they can be used in plant identifications in much the same way that finger prints are used for the identification of criminals.

By sheer coincidence, while reading in the journal section of the library one day in 1991, I came across the work of Prasad (1963) on "Pollen Grain Morphology of certain Malvaceae" which I found very fascinating. I went through the Materials and Methods and I started making enquiries about the possibility of finding the equipment around to perform the acetolysis procedure documented in the journal that would expose the exine structure to be studied. I was fortunate then to discover I could actually carry out the procedure in the laboratory of Prof. J.A. Adegoke who has now retired from the Department of Zoology. I approached him to kindly permit me to use his equipment and he graciously allowed me. I thereafter included palynology aspect in my M.Sc research work on ten species in the genus *Hibiscus* which was later published (Akinwusi and Illoh, 1996).

The main characters of taxonomic value in pollen grain are the number and position of apertures (colpi and pores), pollen wall morphology and sizes of pollen grains. Akinwusi (my maiden name) and Illoh (1996) reported that the various sizes, length of spines, distance between spines, diameter of apertures, distance between apertures and nature of spine end were useful tools in the taxonomy of the *Hibiscus* species studied (Plate 18).

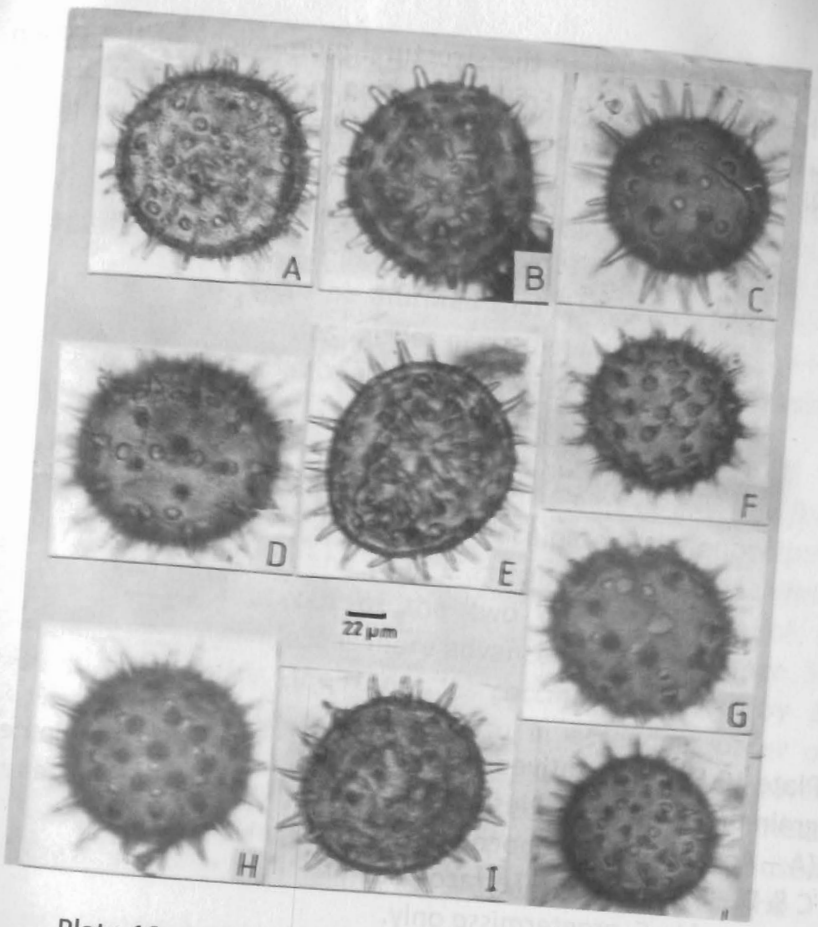


Plate 18: Pollen grains in the genus *Hibiscus* Linn.

Erdtman (1952) classified pollen grains according to size into groups perminuta (diameter less than 10µm), minuta (diameter 10-25µm), media (diameter 25-50µm), magna (diameter 50-100µm), permagna (diameter 100-200µm) and giganta (diameter greater than 200µm). According to this classification, the pollen grains of this genus belong to the size groups magna and permagna. The various sizes, length of spines, distance between spines, diameter of apertures, distance between apertures and nature of spine end were observed to be useful characters in the taxonomy of the *Hibiscus* species studied.

Adedeji (2005b) studied the structural morphology of the pollen of the three species of *Emilia* occurring in Nigeria (Plates 19 and 20). It was the first known report of the palynology of this genus in Nigeria.

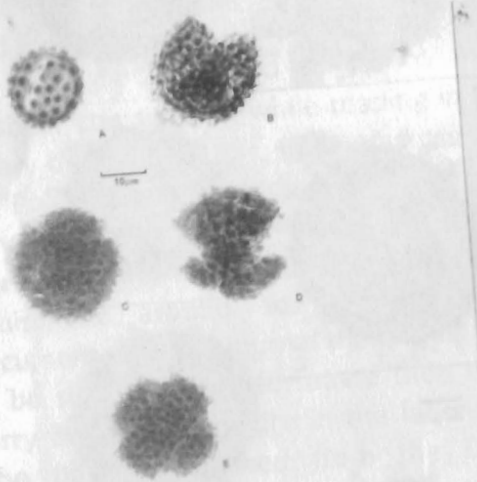


Plate 19:Representatives of pollen grain types in the species of Emilia (A – Acolpate; B – Monocolpate; C & D – Bicolpate; E – Tetracolpate observed in *E. praetermissa* only.

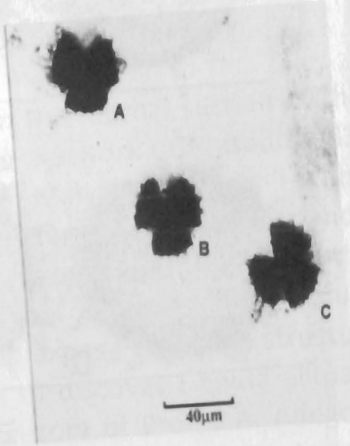


Plate 20: Tricolpate pollens in the genus *Emilia*

Some evolutionary interpretations came to focus from the characters of the pollen grains among these species of *Emilia* studied. According to Walker (1976), two main kinds of pollens are found in angiosperms, these are the monocolpate and tricolpate types. Monocolpate types are characteristic of the primitive dicotyledon and advanced monocotyledon, tricolpate pollens are characteristic of the advanced dicotyledons (Walker 1976). Thus based on this, the study reported that *E. coccinea* with more acolpate and monocolpate pollen grains were more primitive than *E. sonchifolia* and *E. praetermissa*.

According to Olorode and Olorunfemi (1973), *E. praetermissa* is an allotetraploid hybrid of *E. coccinea* and *E. sonchifolia*, that is *E. praetermissa* is more recently developed or more advanced than *E. coccinea* and *E. sonchifolia*. From this study, tetracolpate pollen grain which is a more advanced type of pollen was observed to be present only in *E. praetermissa* but absent in both diploid parents Plate 20E). It could thus be affirmed that the tetracolpate pollen grain observed in only this species of the *Emilia* genus studied was a mark of recent evolutionary development in this allotetraploid hybrid.

The occurrence of more tricolpate pollen grains in *E. sonchifolia* than in *E. coccinea* (Plate 20) and more acolpate and monocolpate pollen grains Plate (20A and B) in *E. coccinea* than *E. sonchifolia* strongly suggest that out of the two diploid parents of *E. praetermissa, E. sonchifolia* is more advanced than *E. coccinea*. So based on this study, the order *E. coccinea* followed by *E. sonchifolia* followed by *E. praetermissa* in ascending order of recent evolutionary development is strongly affirmed. Moreover out of all the pollen grain attributes statistically analysed, number of pores on the pollen grains is an attribute that can be used effectively and reliably to delimit the species of *Emilia* in Nigeria.

In a report on the palynology of the species of the genus *Ocimum* (Arogundade and Adedeji, 2009), pentacolpate pollen grains were encountered in *O. canum* Sims and *O. gratissimum* Linn. (Plate 21). All the species and the variety studied had acolpate to hexacolpate pollen grains while heptacolpate and octacolpate pollen grains were encountered only in *O. canum* which also had the largest size, highest colpi depth, highest number of pores and the largest distance between any pair of apertures.

The advanced dicotyledons have more colpi than the primitive ones with either a colpus (monocolpate) or none at all (acolpate) (Walker, 1976). It can thus be suggested that the heptacolpate and octacolpate pollen grains observed only in *O. canum* is a mark

of recent evolutionary development in the species (Plate 21 N - P). Mr. Vice-Chancellor Sir, this was the first report on the palynology of this genus in Nigeria.

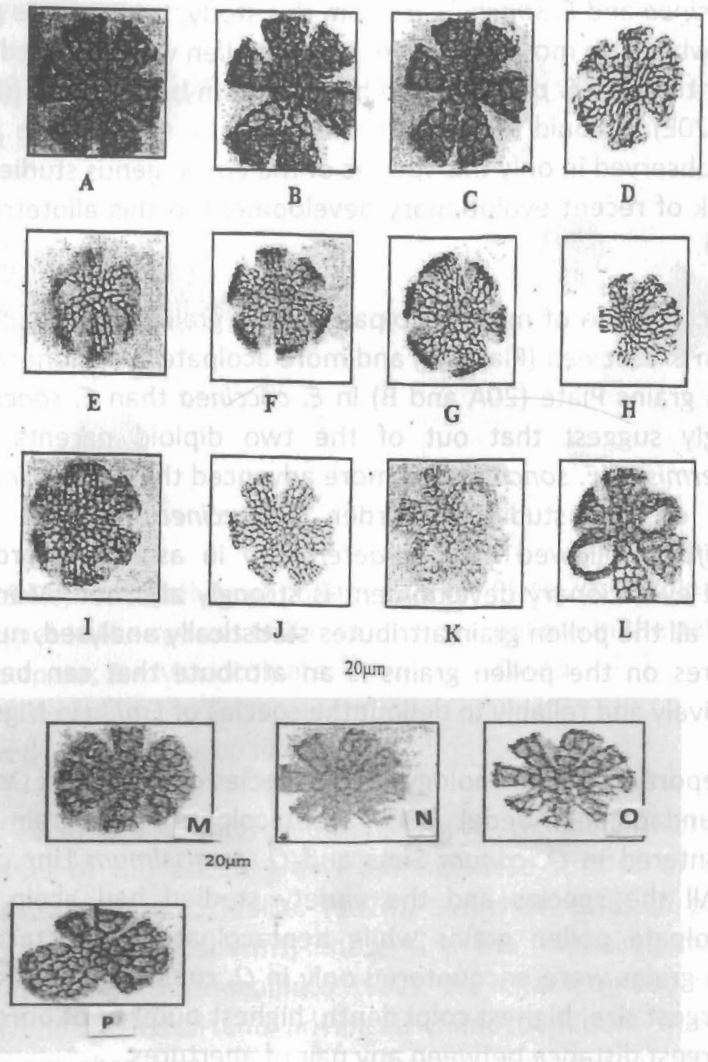


Plate 21: Some pollen grains in the genus *Ocimum;* A-C: Hexacolpate; D: Pentacolpate; E-J: Hexacolpate (Concave in shape); K-L: Hexacolpate (Ribbon-like shape); M: Heptacolpate; N –P: Octacolpate.

In a further palynological study, Adedeji (2010) reported on the exine structure of the genus *Stachytarpheta* (Plate 22).

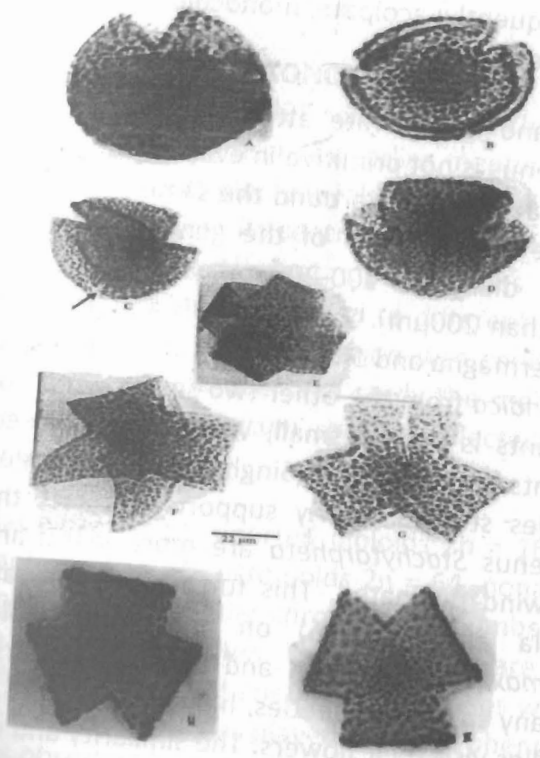


Plate 22: Pollen grains in the genus *Stachytarpheta* (A: Monocolpate; B&D: Bicolpate pollens; C: Tricolpate pollen (arrow on 3rd colpus, slightly opened (observed in all the species); E: Tetracolpate pollen in *S. cayennensis*; F: Tetracolpate pollen in *S. indica*; G: Tetracolpate pollen in *S. angustifolia*; H&I: Tricolpate pollens.

Atkins (1991) reported the pollen morphology of the Brazilian species putative parents *Stachytarpheta sericea* Loes and *S. chamissonis* Walp. and their resulting hybrid. As at the time of this study, there was no report on the pollen morphology of the three species of *Stachytarphata* in Nigeria. This work filled the

knowledge gap in this genus. The study reported that the *Stachytarpheta* pollens are spheroidal to oblate to sub-oblate in shape. They are aperturate, both colpate and porate. Tricolpate type occur most frequently; acolpate, monocolpate, bicolpate and tetracolpate types less frequently.

The multicolpate and multiporate attributes in all the species indicate that the genus is not primitive in evolutionary history and these species probably evolved around the same time. According to pollen size, the pollen grains of the genus fall into groups permagna (pollen diameter 100-200µm) and giganta (pollen diameter greater than 200µm). *S. cayennensis* and *S. angustifolia* belong to group permagna and *S. indica* only in the group giganta. This separates *S. indica* from the other two species. The pollen of anemophilous plants is usually small, while that of insect-and-bird-pollinate plants is usually large (Singh, 2006). The large pollen size in the species studied clearly supports the fact that the flowers in the genus *Stachytarpheta* are more insect-and-bird-pollinated than wind pollinated. This further authenticates the work of Barbola *et al.* (2006) on the floral biology of *Stachytarphata maximiliani* Scham. and its floral visitors which reported that many species of beetles, hemipterans, flies, wasps, bees and butterflies visit their flowers. The similarity and distance indices of the three species show that the highest similarity of closeness (i.e. shortest distance index) is between *S. cayennensis* and *S. angustifolia*, followed by *S. angustifolia* and *S. indica*. In other words, *S. cayennensis* and *S. angustifolia* are the closest, *S. indica* is closer to *S. angustifolia* but farther from *S. cayennensis* which corroborates the studies on the morphology and anatomy of the genus.

An additional palynological study was carried out by Adedeji and Akinniyi (2015) on some species in the family Solanaceae and suggested some evolutionary relationships in the family. Tricolpate pollens were observed in all the species except *Datura metel* Linn. which had only acolpate and monocolpate

pollen types indicating its primitiveness. *Nicotiana tabacum* Linn. was reported to be the only species with tetracolpate pollens which is a mark of recent evolutionary descent when compared with the other species studied.

GENETICS IN PLANT TAXONOMY

Adedeji and Faluyi (2002) conducted further study on *Panicum maximum* (guinea grass). As earlier mentioned, there had been reports of different ploidy levels in the literatures for the species, most especially from its centre of origin in East Africa and it was believed that the different morpho-types initially observed in Southwestern Nigeria belonged to different ploidy levels. Sequel to this, a genetic characterization was conducted to determine the chromosome number and study the meiotic behavior of the accessions of the *Panicum* species collected from the states of Southwestern Nigeria.

Bogdan (1977) had reported diploids 2n = 16, triploids 2n = 24, pentaploids 2n = 40, octoploids 2n = 64, nonaploids 2n = 72 and also plants with irregular chromosome numbers (2n = 31, 36, 37, 38) in *Panicum maximum*. These numbers are obviously products of polyploidization and aneuploid decreases which lend credence to the tremendous roles played by these phenomena in evolution as was observed by Robinson *et al.* (1984) in the evolution of the tribe Heliantheae. Darlington and Wylie (1956) reported a basic number of x=9 for *Panicum maximum* but the findings of the work of Adedeji and Faluyi (2002) do not support this basic number but supports x=8 reported by Hamoud *et al.* (1994) as the basic number. According to Faluyi and Olorode (1987), the occurrence of multivalent and univalents indicates potential for the evolution of aneuploidy and possibilities for change of chromosome number and chromosome re-patterning which might lead to genic imbalance and possibly viable genetic variability in the species. Such chromosomal events could be responsible for the different chromosome numbers reported for *Panicum maximum* by different workers.

All the accessions of *Panicum maximum* studied by Adedeji and Faluyi (2002) had chromosome number 2n=32, including the accessions from the Oil Palm Plantation at Apoje, Ijebu-Igbo in Ogun State, for which a chromosome number of 2n=28 had previously been reported by Olorode (1974). The major features of the chromosome studies were regular occurrence of quadrivalents as Chain IV or ring IV in the meiotic cells at a frequency of 1-5 per cell, regular occurrence of bivalents as ring II and rod II in high frequencies and occasional occurrence of univalents at rather low frequencies (Plate 23). Bivalent pairing was generally of the order of 13 bivalents per cell. All the accessions conformed to a chromosome number of 2n=32 with a basic number of x = 8.

The occurrence of chains and rings of four has posed some major problems for ascertaining of chromosome number in *Panicum maximum*. Olorode (1974) had reported a diploid number of 2n=28 in his collection of *Panicum maximum* from the oil palm plantation in Apoje, Ijebu-Igbo. Very careful cytological studies of many accessions from this location did not support this chromosome number (Adedeji and Faluyi, 2002). A chromosome number of 2n= 28 instead of 2n=32 could easily be arrived at if two chains or rings of four were recorded as 2 ring II or 2 rod II, or if a chain of four was completely missed out. High power photomicrography is very important in ascertaining the chromosome number through meiotic counts.

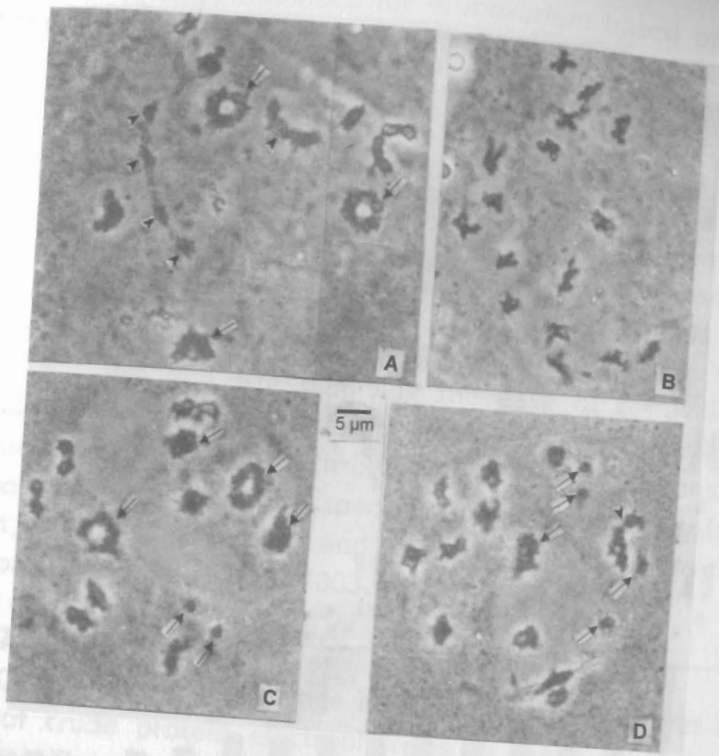


Plate 23: Meiotic chromosomes (diakinesis) of the *Panicum maximum* accessions with 2n=32. A: showing 3 ring IV + 3 chain IV + 3 rod II + 1 ring II; B: showing 16 rod II; C: showing 4 ring IV + 7 rod II + 2I; D: showing I ring IV + 1 Chain IV + 9 rod II + 1 ring II + 4I.

In a further work (Adedeji and Faluyi, 2003a), the mitotic metaphase chromosome morphologies were evaluated in order to assign karyotypic formula to the *Panicum maximum* in Nigeria, which had not been reported before. The chromosomes were mainly sub-metacentric medium small with only chromosome pair one being sub-metacentric medium large (Plate 24).

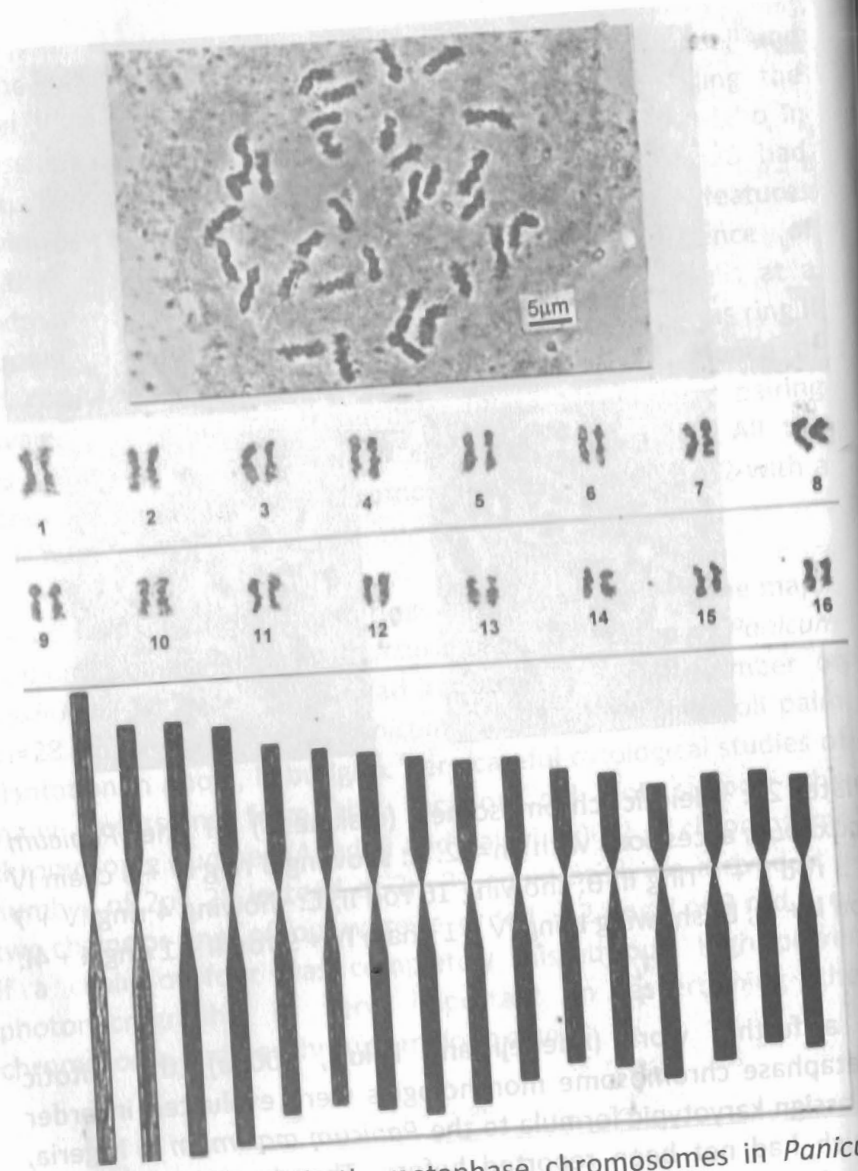


Plate 24: (Top) - Mitotic metaphase chromosomes in *Panicum maximum;* (Middle) - Karyotype of the accessions of *Panicum maximum*; (Below) – Idiogram showing the haploid chromosome complement of the *Panicum maximum* accessions studied.

The karyotypic formula reported for *P. maximum* based on the morphological characteristics of the chromosomes was $1C^{sm}$ + $15B^{sm}$. Superscript sm represents sub-metacentric position of the centromere. The idiogram (Plate 24) shows the karyotype graphically. It is easy to see from this idiogram that the complement falls into 8 size class groups of one chromosome pair per size class. These size classes also fall clearly into centromere type classes. The karyotype conforms to a chromosome complement of 2n= 32. A close look at the idiogram shows the eight different quadrivalent groups as being unique in chromosome form and size signifying the ease of tetravalent associations among each group during meiosis. This however lead to meiotic irregularities, which throws light on the limitations of the reproductive biology in this species shown through very low seed set, low pollen fertility and reduced variability in the population (Adedeji and Faluyi, 2003b).

CHEMOTAXONOMY

Mr Vice-Chancellor Sir, my voyage into chemotaxonomy was in the use of crude protein electrophoresis to make taxonomic deductions. The advantage of electrophoresis, according to Gottlieb (1971), is that variation in banding pattern can directly be equated to variation in genes coding for various proteins. Gel electrophoresis of enzyme and protein have shown that many isoenzyme or polymorphic proteins are widely distributed in higher plants (Cherry and Ory, 1972). Such analyses have been carried out on many species and varieties of plants. Akinwusi (my maiden name) and Illoh, (1995) used gel electrophoresis to evaluate the taxonomic relationship among ten species of *Hibiscus* in Southwestern Nigeria. The crude proteins were extracted and analysed by electrophoretic fractionation. It was reported that the species of the genus had one common band and interspecific bands varying from eight to nine were observed to be common between pairs of species. These confirmed the close genetic relationship of the species. The number and combination

of protein bands were observed to be taxon-specific. Adedeji and Adewale (2006) also used electrophoretic deductions to confirm the evolutionary relationship between the three species of *Emilia* Cass. in Nigeria. We reported an additional protein band in *Emilia praetermissa* (the allotetraploid hybrid) which could be as a result of polyploidy.

PHYSICOCHEMICAL AND NUTRITIVE VALUE STUDIES IN PLANT TAXONOMY

In our study (Adedeji and Faluyi, 2003b) on the forage yield and nutritive value assessments in some accessions of *Panicum maximum* Jacq., we reported that number of tillers per plant stand and dry matter yields of culm, leafy portion and above ground plant were the forage yield characters involved in the determination of forage yield. The nutritive value studies showed that Crude Protein, Potassium, Nitrogen, Sodium and Calcium concentrations were within the recommended range for animal feed while Magnesium and Phosphorus levels were below the recommended range.

Adedeji and Adewale (2004) also carried out a comparative study of the biochemical properties of the fruits of the wild and three varieties of the cultivated tomato in Nigeria. Data (characters compared) collected and compared were: (i) For Proximate: crude protein, ether extract, crude fibre, ash content, moisture (ii) For Enzyme assay and soluble protein determination: Peroxidase activity, catalase activity and Glutathione transferase activity. One major contribution to knowledge from this study was the report of the correlation between the level of peroxidase expression in the wild and cultivated tomato fruit types and the observed shelf keeping quality and disease resistance of such fruits. The wild species which is rarely grown for food or any economic purpose appeared to have better protein and shelf life than the cultivated. Further work (Adedeji *et al.*, 2006) reported that the fruit of the wild tomato plant has a high skin and seed content while the

values for characters such as specific gravity, refractive index, % citric acid and pH did not vary significantly in the cultivated varieties and the wild while total solids, longitudinal and cross-sectional diameters, vitamin C and reducing sugars were significantly different. The work concluded that the wild species contains more solids and is rich in some of the flavor-enhancing constituents such as vitamin C and titrable acidity (% citric acid). Furthermore, it is a high-yielding species and its spherical or round shape will make it more amenable to design consideration parameters than the nonconventional shapes. Thus, the Wild species was recommended for deliberate cultivation.

REPRODUCTIVE BIOLOGY STUDIES IN PLANT TAXONOMY

Mr. Vice-Chancellor Sir, my work in Reproductive Biology was on the family Asteraceae in the genera *Emilia* and *Crassocephalum*. The family Asteraceae is a family of Dicotyledons that does not have the familiar floral structure like many other Dicots and at first glance does not make for interesting reproductive studies. However, about fifteen years ago my interest was aroused in the family through the reading of some works, most especially the works of Prof. M.A. Ayodele of the Federal University of Agriculture, Abeokuta Ogun State, Nigeria. Up till that time, there was no known report about the reproductive biology of the genus *Emilia* which I had taken interest in, so I commenced a study on some aspects of reproductive biology in the genus. My first work on this was published in 2005 (Adedeji, 2005c). It was titled, "Studies on the reproductive biology of *Emilia* (Asteraceae – Senecioneae) 1. Flowering and post-pollination developments in the capitulum" published in Compositae Newsletter, a renowned journal devoted to the family Compositae (now Asteraceae).

In all plants, the demands of flowering and fruiting phases interact. According to Burtt (1975), the structure and organization of the capitulum of the Compositae (or Asteraceae) must meet the demands of both phases. He was also of the opinion that the

study of co-evolution of the flowering and fruiting phases of the life history of plants has been neglected. He therefore called for more studies of these two phases. The condition and exposure of a plant during the flowering and fruiting phases determine the quality of fruits produced and the seeds set. The objective of this preliminary work was to correlate and document the various observations made on the stages of development of floral parts (that is, the capitulum and its contents) via pre-pollination and post-pollination studies in the West African species of *Emilia*.

The work reported that a wall of phyllaries encapsulates the *Emilia* capitulum in bud. In all the species studied, the peripheral florets opened and were pollinated before the central florets (Plate 25A & B).

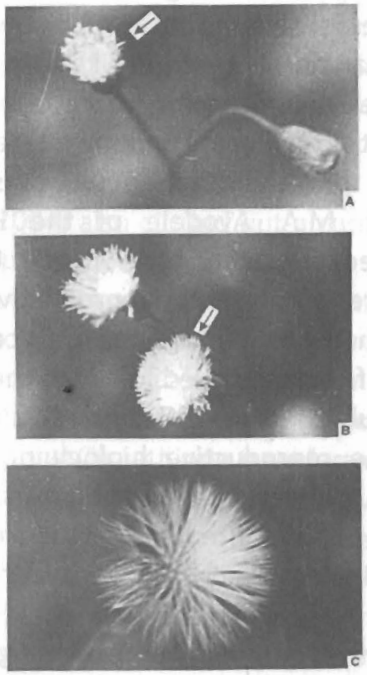


Plate 25: Capitulum development in *Emilia*. A – Peripheral florets opening first (with arrow), Capitulum in bud without arrow; B – Florets fully opened (with arrow); C – Capitulum with pappus.

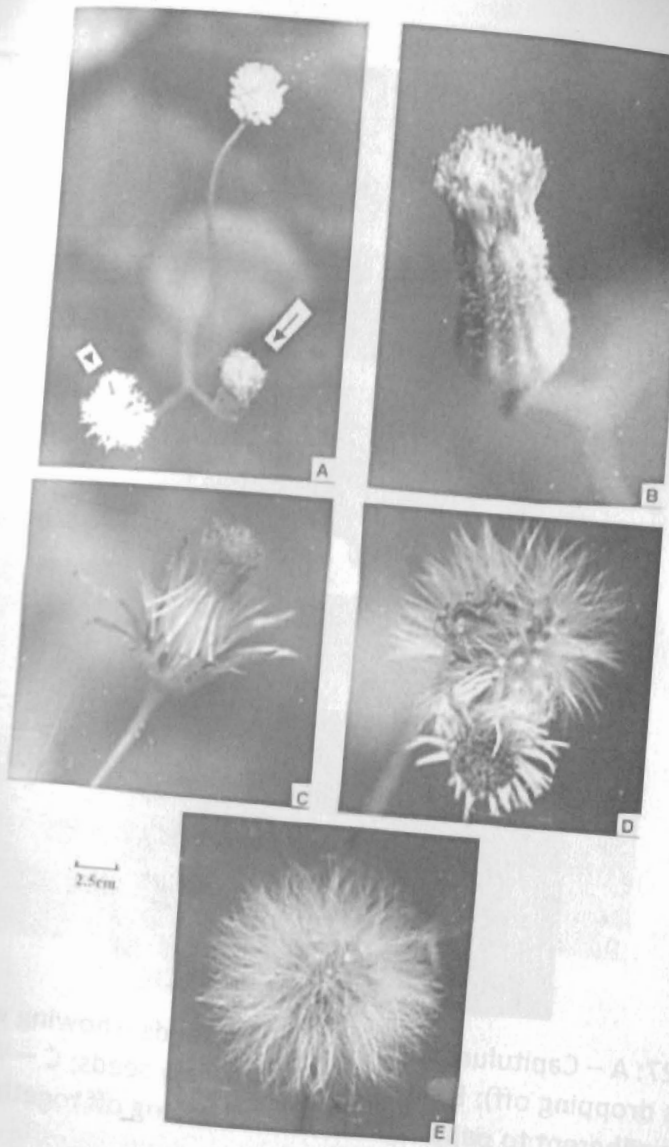


Plate 26: A – Capitulum with withered florets (with arrow); B – Capitulum reclosure; C – Capitulum re-opening; D – Withered floret dropping off (after capitulum re-opening); E – Capitulum with pappus.

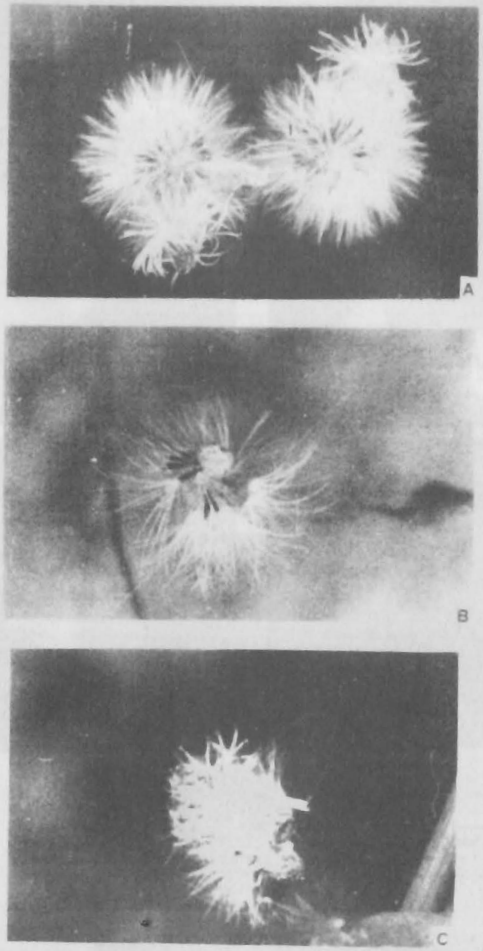


Plate 27: A – Capitulum with pappus and seeds (showing withered florets dropping off); B – Capitulum with few seeds; C – Withered florets adherent to pappus and seeds, dropping off together.

ate 28: A – No receptacle reflexing (with arrow), Partial ceptacle reflexing (without arrow); B & C - Partial receptacle flexing; D – Total receptacle reflexing.

e post pollination sign in all the species was the withering of the rolla of pollinated florets within 18 hours after pollination (Plate A & B). This was followed by the gradual reclosure of the

involucres, the diameter of the capitulum becoming smaller (Plate 26A & B). The phyllaries remained green as the fruits from pollinated florets matured. The capitulum thereafter reopens gradually with the diameter increasing, showing first the pappus of the peripheral matured achenes (Plate 26C). The phyllaries become dried up turning brown. With receptacle reflexing, a pappus subsequently radiate from matured achenes and the withered florets drop off (Plate 26D & E; Plate 27A & B).

Capitulum receptacle may be completely reflexed in some cases becoming turned inside-out when dry, like a closed umbrella (Plate 28D). They may be partially reflexed (Plate 28A-C) or not reflexed at all (Plate 28A, with arrow). However, the incidence of capitulum receptacle reflexing varied among and within the species. Receptacle reflexing was observed as an essential phenomenon aiding efficient fruit dispersal (Ayodele, 1992). This can be compared with the explosive mechanism in some Euphorbiaceae. A combination of light-weight fruits (Plate 27) and fully reflexed receptacle resulted in a longer distance of fruit dispersal, even in the absence of wind (Ayodele, 1992). However, in this study, two factors were observed to be hindering adequate seed dispersal, largely in *E. coccinea* and *E. sonchifolia*, rarely in *praetermissa*. Firstly partial reflexing and no reflexing of the receptacle were encountered in these two species (Plate 28A). Secondly, even when receptacle reflexing was complete, occasionally, the withered florets did not drop off from the pappus (Plate 27C), preventing the pappus from radiating adequately for seed dispersal and eventually dropping off with the pappus and seeds, all together. These may probably be two of the reasons why *E. coccinea* and *E. sonchifolia* are not as widely and evenly distributed as *E. praetermissa*. They usually occur as scattered populations.

Further studies, Adedeji (2006) and Adedeji (2007), reported that floret number displayed low variability within each species

Emilia studied; it is statistically species-specific and thus considered of great diagnostic value in taxonomic evaluation within the genus. Two reproductive propagules were identified in the genus: the seeds and the adventitious roots. The incidence of production of adventitious roots was highest in *E. coccinea*. *E. praetermissa*, the allotetraploid hybrid of *E. coccinea* and *E. sonchifolia* had the shortest number of days to germination and the highest percentage germination performance. The compensatory balance between the reproductive propagules in the genus was explained; *E. coccinea* with the highest incidence of adventitious roots had the lowest percentage germination performance of seeds, while *E. praetermissa* and *E. sonchifolia* with the highest percentage germination performance had the lowest incidence of adventitious roots.

There were similarities, differences and overlaps in the duration of the different stages of the flowering phase among the three species. Flowering of *E. praetermissa*, started faster than that of its parental species. Fruit production performance was found to be associated with a number of vegetative and reproductive characteristics of *Emilia* plants. These included the incidence of stem branching and number of such branches in a plant, the number of terminal capitulum clusters on a plant and the number of capitula per terminal cluster per branch. Fruit production and percentage of fruit-set per capitulum were highest in *E. praetermissa*, followed by *E. sonchifolia* and *E. coccinea*. The high fruit production and quality observed in *E. praetermissa*, the allotetraploid hybrid, is of high adaptational value. It contributes largely to the success of the plant in a wide environmental range.

A study (Sakpere *et al.*, 2013) on the flowering, post-pollination development and propagation of ebolo (*Crassocephalum crepidioides* (Benth.) S. Moore) in Ile-Ife, Nigeria was conducted in order to elucidate the flowering, post-pollination development, seed production, germination potential and propagation of this

species. From the flowering studies, it was reported tha peripheral florets opened and were pollinated before centra florets. The species had appropriate or good pollination period However, there might not have been sufficient pollens fo pollination. The post-pollination period for the maturity of th developing fruits/achenes was observed to be short, the lo number of days for flower re-closure signified lesser number o days for the development and protection of the maturing achene before pappus appearance which led to the dispersal of man immature malformed fruits (Ayodele, 1999; Adedeji, 2007). Parti reflexing and no reflexing of the receptacle were observed to b hindering adequate fruit/seed dispersal. *Crassocephalu crepidioides* produced up to 768-1152 fruits/seeds per pla indicating that the seed production potential of the plant is ve high, with many malformed. Germination percentage was n consistent with age of seed and may be influenced by se maturity. Seeds were observed to be photoblastic (needing lig and very moist soils for optimal germination) and germinati was promoted by soaking in water. It was also established th propagation was hindered by floral initiation.

Adedeji and Faluyi (2006) reported from their study on t agrobotanical and reproductive studies in accessions of *Panic maximum* that the plant is an aggressive colonizer. It flowers ea as days to heading, range from 45-93 days. They are poor seed and propagation is predominantly vegetative: through root-sto and roots from the nodes (adventitious roots) when tillers lo on the ground. Further observations revealed that a tiller or c can have up to eight nodes and each one has the ability of giv rise to a new plant stand which means that from a tiller, up eight new plants can arise. For a plant stand with 100 tiller means at maturity, the plant stand has the ability of giving ris 800 new plant stands. The high reproductive capacity vegetative propagation in addition to the perennial habit co considerable adaptive advantage on *Panicum maximum* and

contribute to its success as a colonizing species. The variations in mean pollen size and percentage fertility emphasize the influence of genetic factors on pollen size and fertility. Pollen fertility was low in all the accessions studied.

NUMERICAL TAXONOMY

Numerical Taxonomy or taximetrics is a classification system in biological systematic which deals with grouping by numerical methods of taxonomic units based on their character states. It aims at creating classification using numeric algorithms like cluster analysis rather than using subjective evaluation of their properties. It utilizes many equally weighted characters and employs clustering and similar algorithms to yield objective groupings. It can be extended to give phylogenetic or diagnostic systems and can be applied to many fields of Science (Sneath and Sokal, 1973). Arogundade and Adedeji (2012) used two numerical methods – Principal Component Analysis (PCA) and Single Linkage Cluster Analysis (SCLA) to assess phenetic relationships of three species and a variety of the genus *Ocimum*. The attributes of fifty-five characters comprising 39 morphological (19 vegetative and 20 floral), 11 anatomical and 5 palynological characters were scored for analysis. Scoring revealed similar characters within the genus and also taxon specific characters. Forty-one characters showed high component loadings with PCA. Results from PCA and SCLA showed that habits, leaf architecture as well as the floral characters are important tools for the classification and delimitation in the genus.

ETHNOBOTANY

Adenegan-Alakinde and Adedeji (2014) reported an ethnobotanical work on the "Utilization of Indian Spinach (*Basella* Linn.) in Ondo State, Nigeria". The paper documented consumers' knowledge on the utility values of *Basella* commonly called Indian spinach or "Amunututu" in Yoruba. Well-structured copies were prepared and one hundred (100) questionnaires were randomly

distributed to consumers in each of the 16 local government areas of Ondo State, Nigeria. Results showed that there were more female respondents (59.4%) than the males (40.6%). This could have resulted from the fact that women make more informed decision on food security in homes. Most consumers preferred Indian spinach to other commonly consumed vegetables and their choice is based on availability and taste. *Basella* could be cooked sole, mixed with blended seeds of egusi (*Citrullus lanatus* (Thunb.) Matsum. & Nakai) or other vegetables. Respondents noted that all the parts of *Basella* are useful (leaves, stem and roots) and they are useful in fertility enhancement, treatment of diabetes, dysentery, constipation, rheumatism, cold, boils and blisters, gonorrhea, hot flushes or internal heat.

3. MY OPPORTUNITIES AND ADMINISTRATIVE EXPERIENCE

Mr. Vice-Chancellor Sir, my distinguished audience, by the grace of God, I have had some opportunities that have equipped me and made me the person I am today. In the year 2000, I applied for a training course in the *Internationale Frauenuniversitat* (*ifu*) in Germany and I was among the people selected from all over the world and was sponsored by the DAAD. It was a very rewarding training that impacted my career positively.

In the year 2007, I became the first female Vice-Dean in the Faculty of Science under the Deanship of Prof. V.O. Olarewaju and being the only female Vice-Dean then in the Committee of Deans I was nominated by the University for Executive Educatior Leadership training for women in the United States of America. It was highly competitive; I had to write essays and face audic interviews and was finally selected as the only candidate fron Nigeria. This led to Executive Leadership Trainings wit certificates at the Harvard University, Boston Massachusetts, th United States of America and Cambridge University, the Unite Kingdom between 2008 and 2009.


Leadership Foundation 2008-2009 Fellows Class

The IWF Leadership Foundation is proud to present the 2008-2009 Class of Fellows. Representing Cameroon, Canada, China, Germany, Jordan, Madagascar, Mexico, Nigeria, South Africa, Spain, Tanzania, and the United States, 27 women leaders were chosen from a highly-competitive global pool of candidates for participation in this internationally expansive program.

The 2008-2009 Fellows Class reflects the growth and reach of the Leadership Foundation Fellows Program, now in its 15th year. This world-class program is advancing women across careers, continents and cultures and helping to shrink the gender gap in leadership through executive development, one-on-one and peer-mentoring, participation in the global leadership exchanges of the IWF, and customized training at the Harvard Business School and Cambridge University's Judge Business School on an annual basis.

LEADERSHIP FOUNDATION

EDUCATE • INSPIRE • EMPOWER

THE NEXT GENERATION OF WOMEN LEADERS

Plate 29: An excerpt from Leadership Foundation, Washington DC

Plate 30: IWF Leadership Foundation Fellows Program
Harvard Business School, Harvard Univerity, USA.

Plate 31: My group members at the Leadership Foundation programme, Judge Business School, Cambridge University, United Kingdom.

It was a marvelous opportunity for me to learn and prepare for leadership roles. The training required that each candidate conduct a project that would be of benefit to the female gender and that would last for as long as possible. This made me to consider instituting a female leadership prize in my Faculty, Faculty of Science that would give recognition to graduating female students that had served in one leadership position or another during the course of their study. When I shared this idea with my classmates at Cambridge University then, they were very excited about it and this led to the institution of "Olubukola Adedeji Female Leadership Prize in the Faculty of Science: for the Best Female Graduating Student with Sterling Qualities and with the Highest Cumulative Grade Point Average (CGPA) of not below Second Class Honours (Upper Division)," which has been awarded every year during convocation since 2009. Later in 2012, I also had the opportunity (fully sponsored) of attending the Senior Academic Leadership Training (SALT) in West Africa at Achimota, Ghana.

University administration is one area in which I can claim to have built up some capacity. It was my privilege to have served in most strata of the University system in the course of my 24 years as a scholar. Within my Department, I had served as undergraduate Course Adviser (1998 to date); Part IV Non-graduating Result Administrator (1998 to 1999); Part III Result Administrator (1999 to 2003); Part IV Graduating Result Administrator (2004 to 2007); Seminar Coordinator (2001 to 2004); Overall Departmental Results Coordinator (2004 to 2005); Secretary, Staff Review Committee (2004 to 2007); Chairperson, Budgeting and Monitoring Committee (2009 to 2011) and also served as the First Female Acting Head, Department of Botany (2011 to 2013).

In my Faculty, Faculty of Science, I had served in various capacities as member, Faculty of Science Lecture Committee (2003 to 2006); Coordinator, Faculty of Science Special Elective (SES 002) (2003 to

2009); Secretary, Faculty of Science Computer Pool Management Committee (2004 to 2007); Member, Faculty of Science Week Planning Committee (2004 to 2006); Chairman, Faculty of Science Board of Examiners (2007 to 2010); Member, Sub-Committee of Committee of Deans for Exam Results Processing (2007 to 2010); Editor-in-Chief, Faculty of Science Newsletter (2007 to 2009); Chairperson, Faculty of Science Committee on Relationship with other Institutions (2007 to 2009); Chairperson, Faculty of Science Consultancy Committee (2007 to 2009); Chairperson, Faculty of Science Committee on Maintenance of Building and Equipment (2007 to 2009); Chairperson, Faculty of Science Time-Table Committee (2007 to 2009); Staff Adviser, Nigerian Association of Science Students, OAU Ile-Ife, Nigeria (2010 to date);Member and later Chairperson, Professor Dapo Afolabi Most Productive Science Scholar of the Year Award (2013 to 2017). Mr. Vice-Chancellor, my revered audience, I have also had the privilege and honour of serving as the first female Vice-Dean (2007 to early 2010) and also the first female Dean (2017 to date) of our great Faculty.

Within the University, I had served as a Member, Technical Sub-Committee, Strategic Planning Committee c/o Housing Unit (1996 to 1998); Member, Committee of Deans Representative on Re-organization of the Transcript Office Committee (2007 to 2009); Member, Sub-committee of Committee of Deans (2007 to 2010); Hall Fellow, Moremi Hall (2007 to 2011); Post-UTME Supervisor/Centre Coordinator and later Post-UTME Screening Committee member, (2008/2009 session to date); Member, System Review Panel into the Department of Architecture (2011); Member, Taskforce on Accreditation of Departments (2011 to 2012); Member, Task Force on Research and Innovation (2011); Member, Internal System Review Panel 4 (2010 to 2011); Member Publicity (Marketing and Promotions) Committee for 50th Anniversary Celebrations (2012); Member, Centralized Hall Maintenance Committee (2012); Hall Mistress, Moremi Hall (2011

to 2016); Member, Business Committee of Senate (2014 to 2015); Member, Honorary Degrees Committee (2014 to 2015); Representative of Senate on Development Committee (2015 to 2017); Member, Students Education Relief Committee (2014 to 2016); Member, Ceremonials Committee (2014 to 2016); Member, Panel of Investigation into the Students Protests of May/June, 2014; Member, Senate Committee on Quality Assurance (2014 to 2015); Member, 2016 to 2020 Strategic Planning Committee (2015); Member of the University Governing Council, 2015 to January 2017; Member, Sub-Committee of Committee of Deans on Security on Campus (2018); Member, Sub-Committee of Committee of Deans on Unwarranted Access to the University E-Portal and Cheating in an Exam with I-Phone and Hi-Tech Wrist Watches (2018).

Outside the University, I had and still am serving as Reviewer for many journals both nationally and internationally. I also examine graduate and post graduate students in many Universities in Nigeria. It has also been my privilege to assess colleagues for professorial chair in a number of Universities in Nigeria.

4. SUMMARY AND RECOMMENDATIONS

Mr. Vice-Chancellor Sir, I joined the services of this University as a Graduate Assistant in 1995 and became a Professor of Botany in 2011. The primary duty of an academic is the training of students both at the undergraduate and postgraduate levels following meaningful and relevant research activities. In my 24 years as an academic staff of various levels in this great University, I have contributed to the training of more than one thousand graduates, many of whom are occupying important positions in both the private and public sectors today. I have supervised many B.Sc. projects and at the postgraduate level, I have trained and supervised successfully many M.Sc. and Ph.D. theses.

My area of interest, specialization and research has been Plant Taxonomy. A Taxonomist is more or less like a "general practitioner". In this lecture, I have been able to show that Taxonomic Evidences (or Characters) for identification and grouping of plants can be harnessed from several disciplines of Botany, to make taxonomic deductions. In the past 24 years as an academic, I have gathered taxonomic evidences from Plant Morphology, Anatomy, Genetics, Palynology, Chemo-data, Reproductive Studies, Numerical Taxonomy and Ethnobotany to identify species of plants, document relationships and also to draw evolutionary trends. I can say unequivocally that my voyage into the world of Plant Taxonomy has been eventful and rewarding. However, I must also be quick to add that, "there are still many rivers to cross, many mountains to climb."

For a long time, Plant Taxonomy has been considered as the science of identifying, naming and classifying (grouping) plants. It is important to know which plants are related to one another in order to predict their properties. Wild relatives of our cultivated plants often have genes that can provide the desirable qualities, such as disease resistance, needed by plant breeders for crop improvement.

As it is usual on an occasion of this nature to make some recommendations based on one's experience and findings, I wish to make the following expedient suggestions:

1. The need for funding for research is highly crucial. This is why I am appealing to the Federal Government of Nigeria and other relevant bodies to do better in the area of funding research. Governments and their agencies at all levels and the private sector must encourage and fund research in the interest of sustainable research, postgraduate training and national development.
2. The herbarium is an integral part of Plant Taxonomy and even Botany as a whole. The herbarium in OAU is known worldwide as "IFE" and has assisted students and researchers all over the nation to identify plants. For some years now, there has not been a Curator in this herbarium. I am using the opportunity of this Lecture to plead that a Curator be employed into the "IFE" herbarium as a matter of urgency.
3. There are two important Taxonomy courses in the Department of Botany that I believe should be incorporated into the Faculty of Pharmacy curriculum or that should be audited by students in the Faculty, BOT 303: Angiosperm Taxonomy and BOT 415: Advanced Plant Taxonomy. These will give them a broader perspective about identifying plants as mis-identification in the case of drug production, most especially in cases where the plants are very close morphologically, could prove to be very detrimental.

5. CONCLUDING REMARKS

Mr. Vice-Chancellor sir, distinguished Ladies and Gentlemen, permit me to acknowledge and appreciate the contributions of some people to my journey in life so far. First and foremost, my heartfelt gratitude goes to my parents, Dr. C.O. and Deaconess R.A. Akinwusi who were my first teachers in life. My mum is an exceptionally sweet mother, a committed, prayerful, loving, caring, understanding, always supportive, inspiring and encouraging mother.

My profound gratitude and appreciation to all who have in one way or another contributed to my career success, particularly Professor E.A. Odu (retired from the Department of Botany) who has always been like a father to me. Thank you sir for your encouragement, support and access to your research facilities early in my academic career, I will always be grateful. My sincere "thank you ma," to mummy Odu too, who has always been there for my family as a pillar of support.

I am grateful to all my mentors, teachers, colleagues and staff of the Department of Botany, for their support and encouragement. It has been a long adventurous journey since 1984 when I stepped into the Department as a young, innocent, unassuming undergraduate. To my students, I say thank you for all the opportunities to learn together. You will get to the top. Very special thanks to all members of this Inaugural Lecture Planning Committee in the Faculty under the Chairmanship of the Vice-Dean, Dr. B.S. Ogundare who actually initiated and inaugurated the committee. You are all highly appreciated.

I particularly thank the pastorate and all members of the Dynamic Christian Assembly (DCA) for the sweet fellowship we have always shared. God bless you all. My appreciation also to my two sisters and their husbands: Professor and Mrs Akindele (FUTA); Professor and Mrs. Ajani (University of Ibadan). It has been wonderful growing up together as siblings from the same womb. Thank you for your love, care and support always. My warm appreciation also, to my childhood and best friend, Mrs 'Funmilayo Babalola and her husband, Professor 'Banji Babalola (currently the Provost of the Postgraduate College in the University of Ibadan), for your love and moral support always. Of equal ranking is Dr. 'Debola Ajiboye who, though we are not from the same womb, has been more of a brother to me and my sisters and a son to my mother since destiny brought us together, you and your darling wife, Mrs. Moronfola Ajiboye are loved and appreciated. Special recognition and thanks to Dr. Wasiu Odufisan who has been a pillar of support to me in recent times.

My warm appreciation goes to Apostle and Mrs T.O. Oyetunmbi who have been much more to me than uncle and aunty. Thank you very much for all your prayers, love and always being there for me and my family. We are very grateful. I put on record and am so grateful for the love, support, understanding, sacrifices and encouragement of my wonderful children, Oluwatooni Praise, Olumide Precious and Oluwadamipe Princess over the years. Continue to grow in God's grace.

It is commonly said that behind every successful man is a woman. Also, behind every successful woman is a man.....not only behind but beside and in front of a successful woman, is a man. My sincere and warm "THANK YOU SWEETHEART" to you my darling husband Prof. A.A. Adedeji (Esq.), for your unalloyed support these past 24 years that we have been actively together. May God continue to bless you in all ways.

Above all, I publicly acknowledge that His grace alone has made me, I owe all to God. He granted me strength, wisdom, knowledge and understanding. He supported me; he fought my battles for me. He is the Immortal, Invisible, only Wise God, my protector, my defender, my helper, my glory, my rock, my strong tower, my help, my sustainer, the lifter up of my head, the most high and my King!, hitherto He has brought His baby girl, "Great is thy faithfulness, O Lord my Father...."

Thank you for your presence and kind attention.

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