

## Biosystematic Studies in Annonaceae II. Vegetative and Floral Morphological Studies of Some Genera of Annonaceae in Nigeria

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**Abstract:** A vegetative and floral morphological study of the species of Annonaceae found in Nigeria was conducted in search of intergeneric characters that may be of taxonomic value in the identification and classification of the species. Life plants, fruits, flowers and seeds were studied from mature plants in the experimental garden. Both qualitative and quantitative characters were recorded. The intergeneric relationships among and between the species of Annonaceae were reported and similarly, additional features that may be of taxonomic value in the classification and identification in the family are apocarpy, syncarpy, phyllotaxy, monopody, sympody, fruit type and fruit shape have been provided.

**Key words:** Vegetative, floral, intergeneric, phyllotaxy, apocarpy, syncarpy, taxonomic

### INTRODUCTION

Annonaceae belongs to the class Magnoliidae in the order Magnoliales. Mabberley (1987), Brummitt (1992) and Folorunso and Olorode (2006a) reported that the family consists of 2,050 species in 125 genera and they are found mainly in the tropics.

The economic, nutritional and medicinal importance of the genera of Annonaceae cannot be over-emphasized. The fruits and seeds of *Xylopia aethiopica* are hot to taste and are sold as a spice and as a substitute for African black pepper (*Piper nigrum*). The crushed seeds rubbed on the forehead cure headache and neuralgia; a decoction of the fruit is used as a lotion for boils and eruptions. An extract of the bark is used in Hausaland as an ointment for sores (Irvine, 1961). The oil from *Xylopia aethiopica* is semi-dry, with relatively high saponification values and used for making alkyl resins which could be used for making paints (Ajiwe *et al.*, 1998). After roasting and grinding, the seeds of *Monodora tenuifolia* are rubbed on the skin for unspecified skin diseases (Irvine, 1961).

Although the Annonaceae as a family is well circumscribed, its infra-familial categories have always been problematic. Classification at these levels are far from being comparable with one another, although they all contain valuable insights (Kessler, 1995).

A lot of work has been done on the family by several workers including Morawetz (1984), Kessler (1995), Johnson (2003) and Folorunso and Olorode (2006a) but detailed study has not been carried out in respect of some genera (*Monodora*, *Dennettia*, *Xylopia* and *Greenwayodendron*) that are being investigated in this study. The aim of this study therefore is to carry out a detailed vegetative and floral morphological studies on the afore-mentioned genera with a view to providing additional features that may be of taxonomic value in the identification and classification in the family.

### MATERIALS AND METHODS

Life plants, fruits, flowers and seeds of ten to fifteen specimens each of *Monodora*, *Cleistopholis*, *Dennettia*, *Xylopia* and *Greenwayodendron* which are largely the available genera found in Nigeria were studied from mature plants between 2000 and 2005 within the experimental garden of Obafemi

Awolowo University Campus, Ile-Ife, Nigeria. The seeds were germinated in plastic buckets and transplanted directly into the soil in the experimental garden. The habit and habitat of the different species were noted. Qualitative morphological characters studied include the shape, base, apex, margin, veins and petioles of leaf, phyllotaxy, presence of stipule, growth type, fruit type, shape and fruit colour when ripe. Also studied are colours of the petals, petal texture, sepal colour, number of stamen and flower type.

The quantitative morphological characters measured are length and breadth of leaves, length and breadth of sepals, length and breadth of petals, length and breadth of fruit, length and breadth of seed, petiole length and pedicel length. Counts were taken of number of veins, seeds, sepals and petals. Free-hand diagrams of morphological characters of each species used for the study were also made to highlight some intergeneric differences.

## RESULTS

The vegetative, floral, fruit and seed characteristics of the species studied are also shown below:

### *Monodora tenuifolia*

**Habit:** A small tree

**Habitat:** Fairly open area, level location, soil humid in remnant secondary forest.

**Leaf:** Alternate, elliptic, chartaceous, apex acute, base acute, margin entire.

**Venation:** Eucamptodromous

**Phyllotaxy:** Distichous

**Petiole:** Inflated, circular in cross section

**Growth:** Sympodial

**Stipule:** Absent

**Flower:** Chasmogamous

**Epicalyx:** Absent

**Sepal:** Green, pubescent at edge, 3 in number, margin entire.

**Petal:** Leathery, light yellow with golden spots, margin wavy, outer petals ovate, inner petals clawed, 6 in number

**Fruit:** Yellow with white patches, syncarpous, round, thick smooth skin (Fig. 1).

### *Greenwayodendron suaveolens*

**Habit:** A shrub

**Habitat:** Cultivated for ornament

**Leaf:** Alternate, lanceolate, less glabrous on the adaxial surface, apex attenuate, base acute, margin wavy.

**Venation:** Eucamptodromous

**Phyllotaxy:** Spiral

**Petiole:** Inflated, circular in cross section

**Growth:** Monopodial

**Stipule:** Absent

**Flower:** Chasmogamous

**Epicalyx:** Absent

**Sepal:** Green, 3 in number, margin entire.

**Petal:** Fleshy, light green, margin entire, lanceolate, 6 in number, rather flimsy at maturity

**Fruit:** Purple, globose carpels, apocarpous, oval, smooth skin (Fig. 2).

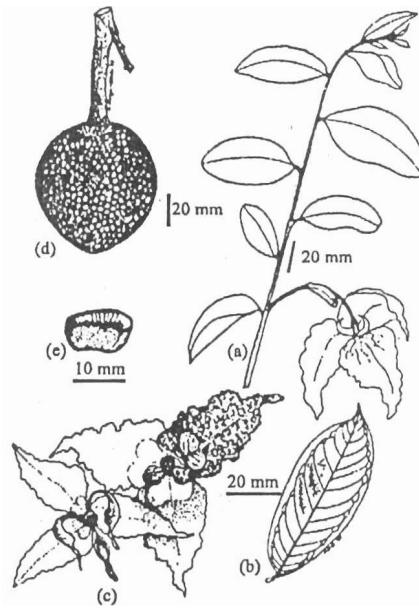


Fig. 1: Diagram of some morphological features of *Monodora tenuifolia* (a) Branch, (b) Leaf, (c) Flower, (d) Fruit and (e) Seed

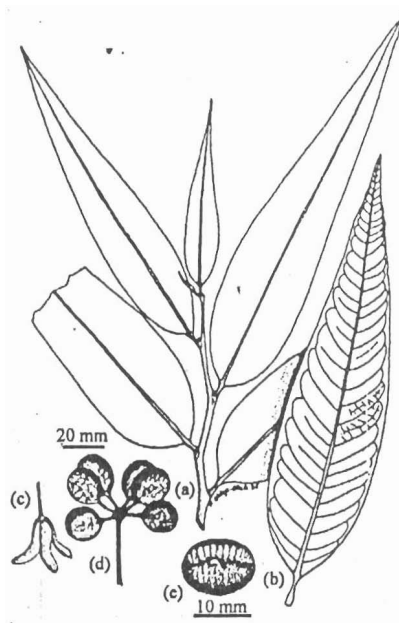


Fig. 2: Diagram of some morphological features of *Greenwayodendron suaveolens* (a) Branch, (b) Leaf, (c) Flower, (d) Fruit and (e) Seed

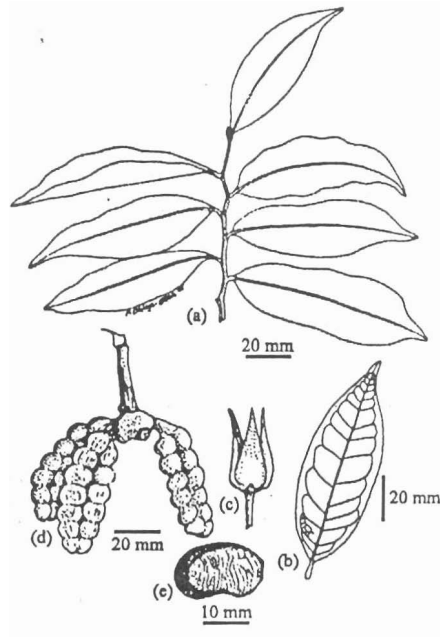


Fig. 3: Diagram of some morphological features of *Dennettia tripetala* (a) Branch, (b) Leaf, (c) Flower, (d) Fruit and (e) Seed

***Dennettia tripetala***

**Habit:** Medium-sized tree

**Habitat:** Forest

**Leaf:** Alternate, oblong, coriaceous, apex acuminate, base cuncate, margin entire.

**Venation:** Eucamptodromous

**Phyllotaxy:** Spiral

**Petiole:** inflated, circular in cross section

**Growth:** Sympodial

**Stipule:** Absent

**Flower:** Chasmogamous

**Epicalyx:** Absent

**Sepal:** Green, very broad, pubescent, 3 in number.

**Petal:** Fleshy, light green, margin entire, lanceolate, 3 in number.

**Fruit:** Light yellow, apocarpous (Fig. 3).

***Xylopi aethiopia***

**Habit:** Medium-sized tree

**Habitat:** Secondary forest

**Leaf:** Alternate, oblong, coriaceous, apex acuminate, base acute, margin entire

**Venation:** Eucamptodromous

**Phyllotaxy:** Spiral

**Petiole:** inflated, circular in cross section

**Growth:** Sympodial

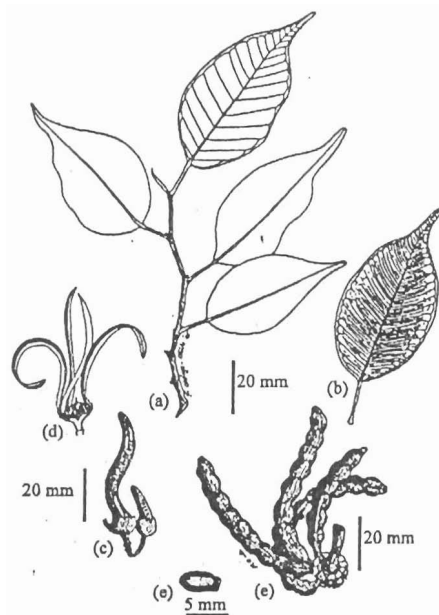


Fig. 4: Diagram of some morphological features of *Xylopia aethiopica* (a) = Branch, (b) = Leaf, (c) = Flower, (d) = Fruit and (e) = Seed

**Stipule:** Absent

**Flower:** Chasmogamous

**Epicalyx:** Absent

**Sepal:** Green, 3 in number, margin entire

**Petal:** Fleshy, light green, margin entire, lanceolate, 6 in number.

**Fruit:** Black, apocarpous (pod like) (Fig. 4).

***Cleistopholis patens:***

**Habit:** Tree

**Habitat:** Secondary forest

**Leaf:** Alternate, lanceolate, coriaceous, adaxial surface glabrous glossy, apex attenuate, base obtuse, margin entire.

**Venation:** Eucamptodromous

**Phyllotaxy:** Distichous

**Petiole:** inflated, circular in cross section

**Growth:** Monopodial

**Stipule:** Absent

**Flower:** Cleistogamous

**Epicalyx:** Absent

**Sepal:** Green, small, 3 in number

**Petal:** Fleshy, green, margin entire, spatulate, 6 in number

**Fruit:** Green, apocarpous, round; one seed per carpel (Fig. 5).

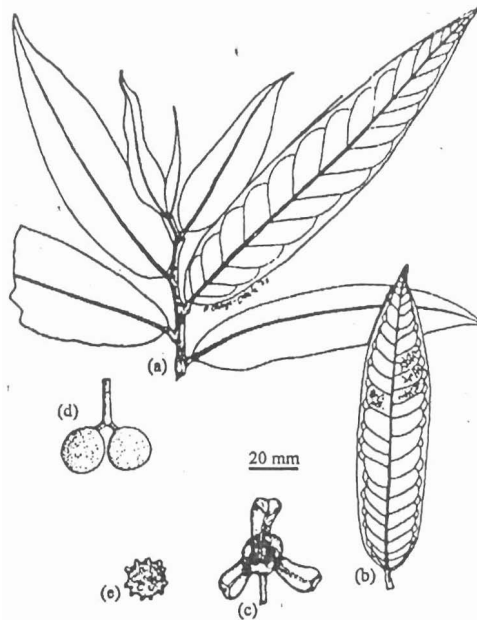


Fig. 5: Diagram of some morphological features of *Cleistopholis patens* (a) Branch, (b) Leaf, (c) Flower, (d) Fruit and (e) Seed

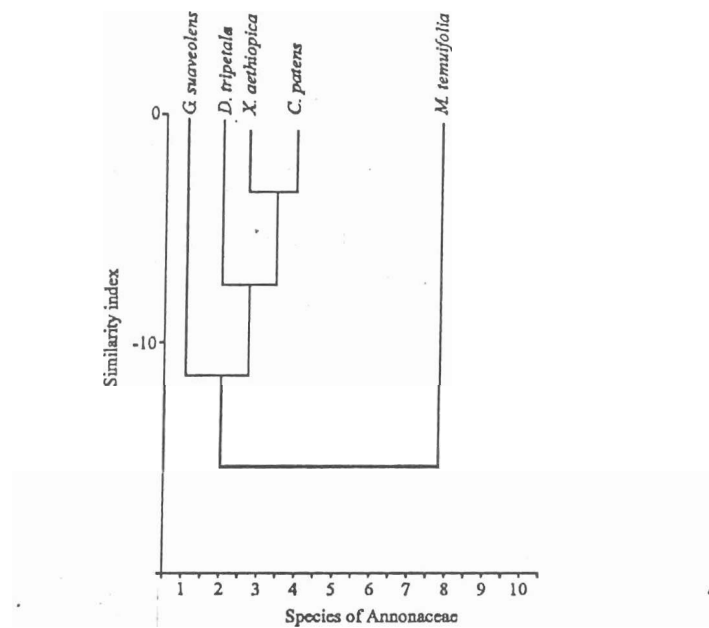


Fig. 6: Dendrogram based on quantitative attributes of vegetative parts of the species of annonaceae

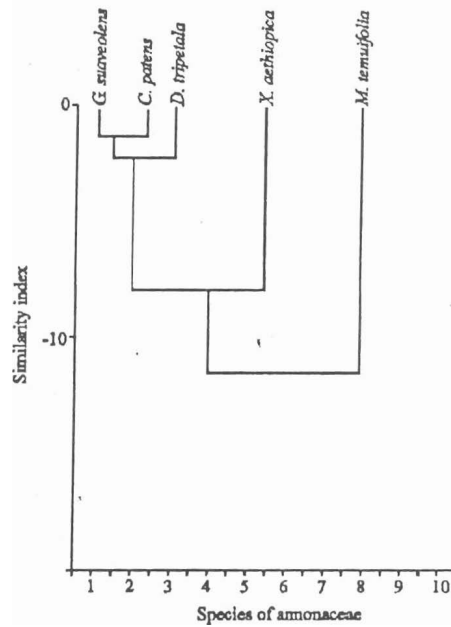


Fig. 7: Dendrogram based on quantitative attributes of floral parts of the species of annonaceae

Quantitative attributes of vegetative parts of the species of Annonaceae shown in Fig. 6. Based on the type of carpels, there are two main clusters, the first main cluster comprises of *Greenwayodendron suaveolens*, *Dennettia tripetala*, *Xylopiya aethiopica* and *Cleistopholis patens* species, all these species are apocarpous. The second main cluster consist of *Monodora tenuifolia* species that are syncarpous. On the basis of phyllotaxy, *Cleistopholis patens* and *Monodora tenuifolia* being distichous are intergenerally related, similarly, *Greenwayodendron suaveolens*, *Dennettia tripetala* and *Xylopiya aethiopica* have spiral phyllotaxy and are intergenerally related. In the cluster of *Greenwayodendron suaveolens*, *Dennettia tripetala* and *Xylopiya aethiopica*, the last two species shared similar growth pattern that is sympodial and are more closely related, *Greenwayodendron suaveolens* have monopodial growth pattern.

*Greenwayodendron suaveolens*, *Cleistopholis patens*, *Dennettia tripetala* and *Xylopiya aethiopica* maintains their apocarpous position while *Monodora tenuifolia* species maintain their syncarpous position. Based on fruit shape, *Greenwayodendron suaveolens* and *Cleistopholis patens* are in a cluster while *Dennettia tripetala* and *Xylopiya aethiopica* are in another cluster (Fig. 7).

## DISCUSSION

Leaf morphology has remained a virtually unexploited tool for systematic studies of the dicotyledons (Hickey, 1973). Distichous phyllotaxy as it appears in *Monodora tenuifolia* and *Cleistopholis patens*, with spiral phyllotaxy in *Greenwayodendron suaveolens*, *Dennettia tripetala* and *Xylopiya aethiopica* are generally encountered in the family Annonaceae (Johnson, 2003). In his study of architectural pattern in Annonaceae, Johnson (2003) observed that phyllotaxy is correlated with orientation of the apical meristem of the primary shoot. In plants with spiral architecture the apex is erect, in plants with distichous architecture the apex is horizontal or drooping. He concluded that Annonaceae are an ecologically important group across the humid tropics, where individuals may be

readily identified to the family level because of the distichous arrangement of the entire, simple, exstipulate leaves on the lateral branches and the aromatic secondary compounds. Folorunso and Olorode (2006a) reported distichous phyllotaxy and sympodial growth as primitive characters in Annonaceae. Hence, the presence of distichous phyllotaxy in *Monodora tenuifolia* species and *Cleistopholis patens* species make them to be primitive species while *Greenwayodendron suaveolens*, *Dennettia tripetala* and *Xylopi aethiopica* species are advanced.

A consideration of the vegetative and floral morphological characters revealed intergeneric relationships between these genera of Annonaceae. Folorunso and Olorode (2002 and 2006b) earlier in their study of the family reported that the presence of common bands among the genera of Annonaceae shows evidence of common evolutionary origin in them. Leaf shape is a strong factor in the clustering of the genera of Annonaceae (Folorunso and Olorode, 2006b). *Cleistopholis patens* and *Greenwayodendron suaveolens* have lanceolate leaves, while *Xylopi aethiopica* and *Dennettia tripetala* present oblong leaves, *Monodora tenuifolia* had elliptic leaves.

The intergeneric relationships between the genera of Annonaceae have been revealed. The characters responsible for these intergeneric relationships are apocarp, syncarp, phyllotaxy, monopody, sympody, fruit type and fruit shape.

In this study, additional features that may be of taxonomic value in the classification and identification in the family have been provided and the intergeneric relationships among and between the species of Annonaceae have been reported.

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