Morphometric Study of *Musanga cecropioides* R. Brown and *Myrianthus arbores* Palisot de Beauvois (Family Cecropiaceae)

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**ABSTRACT:** Morphometric or Numerical taxonomic analysis of 56 quantitative and qualitative characters, obtained from *Musanga cecropioides* R. Brown and five species of *Myrianthus, M. arbores* Palisot de Beauvois, *M. holstii* Engler, *M. libericus* Rendle, *M. preusii* Engler and *M. serratus* (Trecul) Bentham was carried out by calculating similarity and distance indices followed by cluster analysis and construction of a dendrogram for visual appreciation of the taxonomic relationship among these species. The dendrogram showed close similarity among the *Myrianthus* species, with *Musanga cecropioides* clearly distinct from the *Myrianthus* species. This confirms the monotypic status of *Musanga*, with only one species, *Musanga cecropioides*. © JASEM

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The taxonomic status of the species, *Musanga cecropioides* R.Br. and *Myrianthus arbores* P.Beauv. has been problematic (Nyananyo and Offiong, 2012). Both genera have been placed in various families: Urticaceae (Corner, 1962; Ojinnaka et al., 1984, 1986; Airy-Shaw, 1985; Nyananyo, 2006), Moraceae (Keay, 1989; Oke and Odebiyi, 2007; Kadiri and Ajayi, 2009) and Cecropiaceae (Berg, 1978; Burkill, 1985; Setoguchi et al., 1993; Okafor, 2004; Takhtajan, 2009; Nyananyo and Offiong, 2012).

In Engler’s (1889) classification of the Moraceae, the two African genera, *Musanga* and *Myrianthus*, together with the neotropical genus, *Cecropia* Loefl., *Coussapotia* Poepp. & Endl. and the Asiatic genus, *Poikilospermum* Zippelius ex Miguel., constituted the subfamily Conoechoaloideae (Ruiter, 1976). Corner (1962), transferred the whole subfamily to the Urticaceae. However, Wee-Lek (1963), suggested an even more unnatural system of classification based on fruit size. He placed *Musanga* and other microsporogenous genera of the Conoechoaloideae in the Urticaceae leaving the megasporogenous genera including *Myrianthus* in the Moraceae. The classification of Corner (1962) had support from various workers using evidence from such systematic lines of evidence as gross morphology and phytochemistry (Ruiter, 1976; Ojinnaka et al., 1986).

Berg (1978), proposed the new family, Cercropiaceae, to incorporate the genera, *Musanga* and *Myrianthus* based on morphological characters, pointing out that they apparently form a natural coherent group distinct from members of the Moraceae and Urticaceae.

The confused taxonomic history of Cecropiaceae (Setoguchi et al., 1993) reflects the fact that Cecropiaceae is intermediate between the Moraceae, with which they share possession of lactifers, and the Urticaceae with which they share orthotropous sub-basal or basal ovule (Berg, 1978; Takhtajan, 2009).

The isolation of tormentic and euscaphic acids from *Musanga* and *Myrianthus* and their absence in other genera of the families, Moraceae and Urticaceae (Ojinnaka et al., 1984, 1986), provided a chemical systematic line of evidence in support of Berg’s (1978) proposal for a separate family Cercropiaceae for the genera, *Musanga* and *Myrianthus*.

Morphometrics also known as Numerical taxonomy can be defined as the quantitative analyses of biological form. It has been widely used in a lot of disciplines including Systematics (Henderson, 2006). Morphometrics or Numerical taxonomy is the application of various mathematical procedures to numerically encode characters. This practice integrates data from a wide variety of sources such as anatomy sensu lato, chemistry, cytology, ecology, genetics, geography, palynology, physiology etc. (Soladoye et al., 2010). Actual morphometric or numerical taxonomic studies of plant taxa were very scarce before the 1960s (Dogan et al., 2009). The product of this exercise is usually accepted as unbiased and therefore objective and used to classify or place...
taxa in an appropriate and acceptable hierarchy (Quike, 1993). Morphometrics or Numerical taxonomy has previously been applied in the classification of a number of plant taxa (El-Gazzar, 2008; Dogan et al., 2009; Soladoye et al., 2010).

In this investigation, morphometrics or numerical taxonomy (which is not a systematic line of evidence) has been applied to clarify the doubtful taxonomic status of *Musanga cecropioides* and five species of *Myrianthus*, based on quantitative and qualitative characters.

**MATERIALS AND METHODS**

*Musanga cecropioides* R. Brown and five (5) species of *Myrianthus (M. arboreus* Palisot de Beauvois., *M. holstii* Engler, *M. libericus* Rendle, *M. preusii* Engler) and *M. serratus* (Trecul) Bentham) were grouped by cluster analysis using the un-weighted pair group method analysis (UPGMA) based on the similarity matrix of Euclidean distances of 56 quantitative and qualitative characters. The characters were selected without prejudice. These characters obtained from the leaf, habit, stem, flower and fruit structure, seed, chemical components (leaf and stem), anatomy (leaf and stem), pollen morphology, and ecology were placed under ten headings (Table 1). To trace the relationship among the taxa studied, the data were standardized before clustering and a dendrogram was constructed. The statistical analyses were performed using the PAST software.

| Table 1: List of Characters and Character States used in the Numerical Analysis |
|-----------------------------|---------------------------|---------------------------|
| **A**                      | **LEAVES**                | **Leaf margin**           |
| 1 Leaf margin              | 1 – serrate               | 10 Lateral nerves         |
| 2 Leaf lobe                | 1 – not lobed             | 11 Length                 |
| 3 Leaf nature              | 1 – simple                | 12 Width                  |
| 4 Venation                 | 2 – reticulate            |                            |
| 5 Phyllotaxy               | 3 – parallel              |                            |
| 6 Pubescence               | 2 – acute                 |                            |
| 7 Apex                     | 3 – obtuse                |                            |
| 8 Base:                    | 1 – ovate                 |                            |
| 9 Shape                    | 2 – elliptic              |                            |
| 10 Petiole length          | 3 – oblanceolate          |                            |
| 11 Length                  | 4 – lanceolate            |                            |
| 12 Width                   | 5 – oblanceolate          |                            |
| 13 Stipules                | 30 Ovary                  |                            |
| 14 Phyllotaxy              | 2 – regular               |                            |
| 15 Petiole                 | 1 – inferior              |                            |
| 16 Nature of stamen        | 2 – superior              |                            |
| 17 Petiole                 | 1 – branched              |                            |
| 18 Nature of style         | 2 – erect                 |                            |
| 19 Epiphytic               | 3 – 10 cm                 |                            |
| 20 Nature of style         | 4 – 20 cm                 |                            |
| 21 Nature of style         | 5 – 30 cm                 |                            |
| 22 Nature of style         | 6 – 10 cm                 |                            |
| 23 Nature of style         | 7 – 20 cm                 |                            |
| 24 Nature of style         | 8 – 30 cm                 |                            |
| 25 Nature of style         | 9 – 50 cm                 |                            |
| 26 Nature of style         | 10 – 70 cm                |                            |
| 27 Nature of style         | 11 – 90 cm                |                            |
| 28 Nature of style         | 12 – 110 cm               |                            |
| 29 Nature of style         | 13 – 130 cm               |                            |
| 30 Nature of style         | 14 – 150 cm               |                            |
| 31 Nature of style         | 15 – 170 cm               |                            |
| 32 Nature of style         | 16 – 190 cm               |                            |
| 33 Nature of style         | 17 – 210 cm               |                            |
| 34 Nature of style         | 18 – 230 cm               |                            |
| 35 Nature of style         | 19 – 250 cm               |                            |
| 36 Nature of style         | 20 – 270 cm               |                            |
| 37 Nature of style         | 21 – 290 cm               |                            |
| 38 Nature of style         | 22 – 310 cm               |                            |
| 39 Nature of style         | 23 – 330 cm               |                            |
| 40 Nature of style         | 24 – 350 cm               |                            |
| 41 Nature of style         | 25 – 370 cm               |                            |
| 42 Nature of style         | 26 – 390 cm               |                            |
| 43 Nature of style         | 27 – 410 cm               |                            |
| 44 Nature of style         | 28 – 430 cm               |                            |
| 45 Nature of style         | 29 – 450 cm               |                            |
| 46 Nature of style         | 30 – 470 cm               |                            |
| 47 Nature of style         | 31 – 490 cm               |                            |
| 48 Nature of style         | 32 – 510 cm               |                            |
| 49 Nature of style         | 33 – 530 cm               |                            |
| 50 Nature of style         | 34 – 550 cm               |                            |
| 51 Nature of style         | 35 – 570 cm               |                            |
| 52 Nature of style         | 36 – 590 cm               |                            |
| 53 Nature of style         | 37 – 610 cm               |                            |
| 54 Nature of style         | 38 – 630 cm               |                            |
| 55 Nature of style         | 39 – 650 cm               |                            |
| 56 Nature of style         | 40 – 670 cm               |                            |

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RESULTS AND DISCUSSION

In the present study, six taxa were evaluated on the basis of data matrix generated from 56 quantitative and qualitative characters (Table 1). A similarity matrix based on Euclidean distances for the six taxa is presented in Table 2. The constructed dendrogram

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based on the Euclidean distances from the data matrix (Appendix 1) divides the taxa into three clusters, viz. cluster \( G_1 \) and subclusters \( SG_1 \) and \( SG_2 \) (Figure 1).

Cluster 1 (\( G_1 \)) consists of only one species, \textit{Musanga cecropioides}. While cluster 2 (\( G_2 \)) has two subclusters, \( SG_1 \) and \( SG_2 \). Subcluster \( SG_1 \) comprises of \textit{Myrianthus arboreus}, \textit{M. holstii} and \textit{M. preussii}, in which their leaves are palmately compound, with 5-7 serrated leaflets. Subcluster \( SG_2 \) comprises of \textit{Myrianthus serratus} and \textit{M. libericus}, in which both have simple leaves with fine toothed margins. This result confirms the report of Hutchinson & Dalziel, 1954.

The dendrogram showed that \textit{Myrianthus arboreus}, \textit{M. holstii} and \textit{M. preussii} are closely related with \textit{M. arboreus} and \textit{M. holstii} being more closely related. While \textit{M. serratus} and \textit{M. libericus} are closely related. \textit{Musanga cecropioides} appeared to be distinct from all the \textit{Myrianthus} species.

### Table 2: Similarity matrix of \textit{Musanga cecropioides} and 5 species of \textit{Myrianthus}.

|                | \textit{Musanga cecropioides} R.Br. | Myrianthus arboreus P.Beauv. | \textit{M. serratus} Trecul Benth. | \textit{M. libericus} Rendle | \textit{M. holstii} Engl. | \textit{M. preussii} Engl. |
|----------------|-----------------------------------|-------------------------------|---------------------------------|-----------------------------|--------------------------|--------------------------|
| \textit{G}_1   | 0                                 | 7.6811                        | 8.4261                          | 8.6603                      | 8.7178                   | 7.4162                   |
| \textit{SG}_1  | 7.6811                            | 0                             | 6.4807                          | 6.3246                      | 5.5678                   | 6.1644                   |
| \textit{SG}_2  | 6.4807                            | 0                             | 6.3246                          | 5.6569                      | 7                        | 8.4853                   |
| \textit{G}_2   | 8.4261                            | 6.4807                        | 0                               | 5.6569                      | 7                        | 8.4853                   |
| \textit{G}_1   | 8.6603                            | 6.3246                        | 5.6569                          | 0                           | 7.4162                   | 9.5917                   |
| \textit{SG}_1  | 8.7178                            | 5.6569                        | 7                               | 7.4162                      | 0                        | 6.4031                   |
| \textit{SG}_2  | 7.4162                            | 6.1644                        | 8.4853                          | 9.5917                      | 6.4031                   | 0                        |

**Fig 1:** Dendrogram showing the relationship between \textit{Musanga cecropioides} and \textit{Myrianthus} species (where G and SG represent Group and Subgroup respectively)

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### APPENDIX 1

**Data Matrix of Characters used in Numerical Analysis**

| OTUs | CHARACTER NUMBER |
|------|------------------|
| 1    | 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 |
| Musanga cecropioides R.Br. | 1 1 2 2 1 1 1 5 3 5 1 1 4 1 6 2 2 1 1 2 1 2 3 6 2 2 1 |
| Myrianthus arboreus P.Beauv. | 2 1 2 2 3 1 2 1 5 6 3 5 1 1 4 1 8 2 2 1 1 2 1 2 1 6 0 2 1 |
| *M. serratus* (trecul) Benth | 2 1 1 2 2 1 5 4 6 4 6 5 1 2 1 7 3 2 1 1 2 1 2 1 7 0 2 1 |
| *M. libericrus* Rendle | 2 3 1 2 2 1 4 1 2 4 6 6 1 2 1 7 3 2 1 1 2 1 2 1 6 0 2 1 |
| *M. holstii* Engl. | 5 3 2 2 3 1 2 1 7 6 6 5 1 4 1 8 3 2 1 1 2 1 2 1 3 6 0 2 1 |
| *M. preussii* Engl. | 5 1 2 2 3 1 1 1 7 5 3 1 1 4 1 7 3 2 1 1 2 1 2 1 6 0 2 1 |

| OTUS | CHARACTER NUMBER |
|------|------------------|
| 29   | 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 |
| Musanga cecropioides R.Br. | 2 2 2 1 2 1 1 5 2 1 3 0 2 6 2 2 1 1 3 0 0 0 1 1 0 2 1 3 |
| Myrianthus arboreus P.Beauv. | 2 2 2 1 2 1 3 3 1 2 6 2 2 1 1 3 0 0 0 1 1 0 2 1 3 |
| *M. serratus* (trecul) Benth | 2 2 2 2 2 1 2 4 1 3 1 2 6 2 2 1 1 3 0 0 0 1 1 0 2 1 3 |
| *M. libericrus* Rendle | 2 2 2 2 2 1 2 4 1 3 3 1 2 6 2 2 1 1 3 0 0 0 1 1 0 2 1 3 |
| *M. holstii* Engl. | 2 2 2 2 2 1 2 3 1 3 3 1 2 6 2 2 1 1 3 0 0 0 1 1 0 2 1 3 |
| *M. preussii* Engl. | 2 2 2 2 2 1 2 3 1 3 3 1 2 6 2 2 1 1 3 0 0 0 1 1 0 2 1 3 |

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