The Biosystematics of the African Subgenus of *Vigna* sari (Fabales) in Nigeria, I, Taximetrical Approach.

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ABSTRACT: A survey of the biosystematics of *Vigna* is done. 36 species of the Africa subgenus of *Vigna* was subjected to various taximetric processes. The results of the processes suggest that the *Vigna* subgenus has 6 sections. The occurrence of "singletons" does not counter the demarcation of the 6 sections. The similarity levels of the clusters are greatly enhanced. The results of both the cluster link and the PCoA are in agreement based on the unbiased characters.

INTRODUCTION

Vigna is a very large and immensely variable genus of herbaceous trailing and climbing species, with wide range of contrasting varieties. It is cultivated or found wild in various vegetation zones of Nigeria. It is subdivided into 8 subgenera but modified by [1] to 7 subgenera. The African subgenus is divided into six sections; Vigna, Comosae, Macrodonate, Reliculatae, Liebrechtsia and Catjang. Of the 36 species of the African subgenus about 20 species are native to Nigeria and have their origin in the northern part of the country. The seed constitute a staple food in many communities and provides a steady and basic source of protein.

Various methods have been employed in the systematics and evolutionary studies of higher plants. These studies have been done mainly on the economic genera, the legumes occupying a very significant position among these genera.

[2] studied the systematics of *Lotus* in Canada using Cytotaxonomy and numerical chemotaxonomy. [3], [4] and [5] have done separate works on the classification of angiosperm generally and more specifically on the legumes.

TAXIMETRICS

[5], [6] has explained the merits of taximetrics as a method of classification. He has used the method to resolve some of the major discrepancies within the systematics of the genus *Crotolaria*. This method has been acknowledged by [4]. The present report employs the method of taximetrics in the systematics of the African subgenus of *Vigna*, to eliminate some of these discrepancies.

MATERIALS AND METHODS

The data for the present work were based on a large number of characters chosen without bias to variation and relevance.

The number of characters studied was maximized to provide an embracing system containing all the aspects within the orthodox classification. The characters are presented in Table I.

Table I: List of characters used in the presented study, made up to 41 unbiased variations.

s/n	Characters
(1)	Presence of auxiliary buds.
(2)	Seed coat colour
(3)	Pod colour
(4)	Length of inflorescence
(5)	Type of seed coat
(6)	Colour of leaf
(7)	Type of pod
(8)	Height of plant
(9)	Length of peduncle
(10)	Colour of flower
(11)	Leaf length
(12)	Leaf breadth
(13)	Number of flowers
(14)	Standard petal width
(15)	Petal length
(16)	Pod length
(17)	Pod width
(18)	Seed length
(19)	Seed width
(20)	Pigmentation on leaf
(21)	Pod weight
(22)	Seed weight
(23)	Number of seed/pod
(24)	Number branches/plant
(25)	Number of main stem modes

Table II: Procedures in taximetrics use in studies of the Vigna species.

	Cluster Link Type	Reference
(1)	(i) Median sort or (unweighted) pair group average	[7]
	(ii) Weighted group average	[8]
	(iii) Error sum of squares	[9]
(2)	Principal Component (Coordinates) analysis PCoA	[10]

Table III: Accessions of the 20 species of Vigna used in the analysis

	SPECIES	ACCESSION NUMBER
1.	*Vigna unguiculata* L.	KV1
2.	*V. radiata* (L) R. Wilczek	KV2
3.	*V. unguiculata* L.	KV3
4.	*V. umbellata* (Thunb) Ohwi and Ohashi	KV4
5.	*V. aconitifolia* (Jacq) Marechal	KV5
6.	*V. biliflora* L.	KV6
7.	*V. unguiculata* L.	KV7
8.	*V. sesquipedalis* (L) Verdc.	KV8
9.	*V. biliflora* L.	KV9
10.	*V. nervosa* Markotter	KV11
11.	*V. nervosa* Markotter	KV13
12.	*V. hosei* Craib	KV14
13.	*V. subtervanea* L.	KV15
14.	*V. fructescens* A. Richard	KV20
15.	*V. unguiculata* L.	KV21
16.	*V. unguiculata* L.	KV22
17.	*V. tenuis* (E. May) Dietr	KV23
18.	*V. angustifoliolata* Verdc	KV24
19.	*V. pubescens* Wilczek	KV25
20.	*V. cylindrica* (L) Skeels	KV26
21.	*V. pubescens* Wilczek	KV27
22.	*V. sinensis* (L) Sari ex Hassk	KV28
23.	*V. mungo* (L) Hepper	KV29
24.	*V. angularis* (Willd) Ohwir Ohashi	KV30
25.	*V. vexillata* (L) A. Rich	KV31
26.	*V. fructescens* A. Richard	KV32
27.	*V. cylindrica* (L) Skeels	KV33
28.	*V. mungo* (L) Hepper	KV34
29.	*V. unguiculata* L.	KV35
30	*V. trilobata* L.	KV36
31.	*V. glabrescens* L.	KV37
32.	*V. angustifolialata* Verdc	KV38
33.	*V. hosei* Craib	KV39
34.	*V. pubescens* Wilczek	KV40
35.	*V. cylindrica* (L) Skeels	KV41
36.	*V. radiata* (L) R. Wilczek	KV42

The data were recorded for the 36 accessions of 20 species and subjected to four taximetric procedure listed in Table 2. Table 3 consist the 36 accessions of the 20 species studied. All the data were duplicated and allowance was made for missing data at all times.

The computer programmes were performed on a IBM model 55 x Intel 286. Computer using the FORTRAN program graph. The print out was clear and displayed the clustering at the different levels. PCoA was performed with the same machine, using the similarity matrix produced by the clasp programme. The program could carry up to 120 units, thus 29 characters studied presented no problem. All the two dimensional projections of the ten – dimensional coordinates were then plotted on the graph plotter using the same computer. The character analysis used as the basis for further selection was produced using the PCoA.

RESULTS

Results of single link clustering using the 41 unbiased variations character are presented in Fig. 1. There is clearly a successful hierarchy in association. The sub graphs simplified the clusters and reduce singletons. The similarity levels within a cluster is also enhanced reaching up to S = 0.87. The few singletons are in fact the outlying points to which interlinks are achieved. The subspecies dekindtiana seems to be a product of multiple hybrids existing as links with more than two dusters.

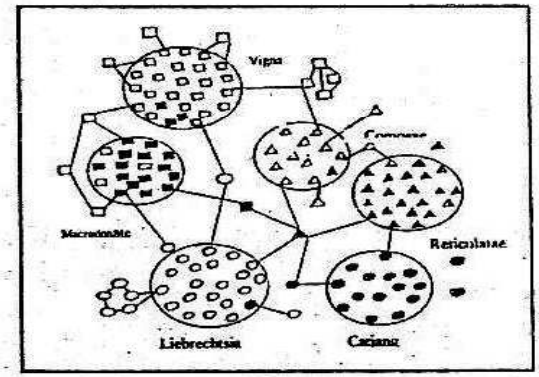

Fig 1: Subgraph of the single-link clustering of 36 assessions of African subgenus 0 Vigna using the 41 characters > 0.80.

In general the structure of groupings shown in Fig. 1 lends credence to the model of [1]. The six clusters conform to the subdivision of Marechal except that the *Vigna pubescent* which was classed as variety of subspecies dekindtiana tends to show more affinity with subspecies *stenophylla*. The occurrence of two sub clusters close to *Vigna* and one close Comosae may justify the previous scheme of 9 section of the African sub genus of [11].

Fig II represents the schematic arrangement of the sections of the African subgenus of *Vigna*. The sections are clearly defined and the links are not ambiguous. Section *Vigna* seems to enjoy a more central but high position in

the arrangement. Section Reticulatae separates as an intermediate between Comosae and Catjang.

The result of PCoA (Fig III) closely conforms to the cluster link analysis. Six major clusters of the PCoA fits the six clusters of the single links clusters.

The first principal axis accounts for about 13% of the total variation and the first 6 principal axes for about 38% of the total variation. The seventh axis contributes only 4.1% of total variation. The arrangements of the sections on the PCoA are presented in Fig IV.

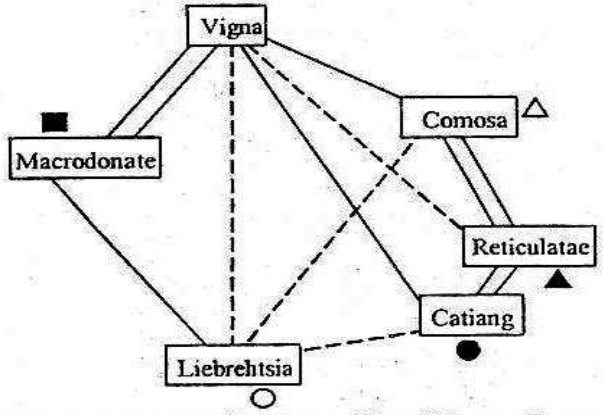

Fig II: Schematic arrangement of sections of the African subgenus Vigna. Strong morphological affinities are represented by double lines, some resemblances are represented by single lines and dotted liens represent slight resemblances.

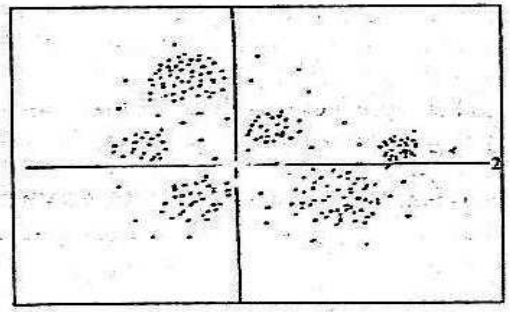

Fig III: Point projections representing 36 assession of Vigna distribution in I and II character dimension of the PCoA using the 41 characters.

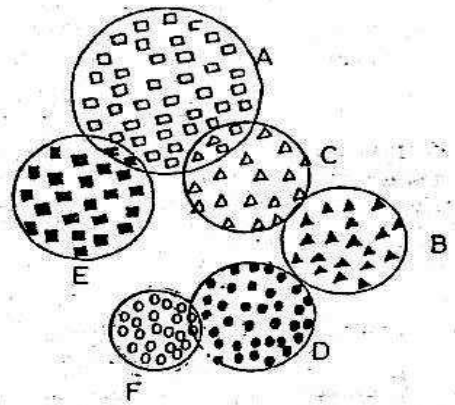

Fig IV: Schematic arrangement derived from the PCoA using the 41 characters of the 36 assessions of the African subgenus of Vigna.

Cluster A equates to the section *Vigna*. It also maintains the highest level on the chart. The second level cluster (Cluster B) also conforms with reticulates. Cluster C, D and G are closed and linked to one another with Comosae, cluster D conforms with Catjang while E and F conforms with sections Macrodonate and Liebrechtsia respectively.

DISCUSSION

The most important requirement in any taxonomic survey is the delimitation of clear-cut groups for further study. Another important factor in a taxonomic method is its ability to remove some discrepancies and or provide solutions to perennial problems already existing systems. The present report has reestablished the usefulness of taximetric in the systematics of plants. It has also reconfirmed the earlier report [11] as the amended by [1]. The result shows good clustering of the different subspecies of *Vigna*.

The uncertainty in the delimitation and the actual number of sections in the systematics of the *Vigna* has been removed. Even though singletons occur, their occurrence is not strong enough to distort the pattern of groupings.

The two methods, cluster link and PCoA, producing precisely the same result, confirm the selection of characters as adequate.

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zone, and therefore blast could be fired without risk of damage to structures.

(2) Spreading energy loss ranges between - 0.97 dB and 1.07 dB. This result confirms that amplitude and energy decay with offset [6,13].

(3) Exponential relations have been formulated for the region provided 2 kg charge is maintained:

(i) Amplitude (A)-Offset (X) relation: $A = 0.059e^{-0.0043X}$

(ii) Velocity (V)-Qffset (X) relation: $V = 4.8879e^{-0.0059x}$

(iii) Spreading Energy (E) – Offset (X) relation:

$$E = 9.4681 \text{ Log}_e X - 49.944$$

These relations can be used to determine the amplitude, velocity and energy loss for working out programme in the absence of any other information prior to seismic exploration in the region.

The information obtained from this study is vital to the oil exploration stakeholders and explorationists, especially in designing omissions and safe offset distances from structures.

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