International Journal of Life Science and Agriculture Research
ISSN (Print): 2833-2091, ISSN (Online): 2833-2105
Volume 05 Issue 08 August 2026
DOI: https://doi.org/10.55677/ijlsar/V05I08Y2026-06
Impact Factor: 7.88, Page No: 624-640

A Quantitative Evaluation of the Taxonomic Revision of Nigerian Eriosema Species through Numerical Approaches

Aliyu Habib[1], Abubakar Bello[2], Umar Lawal[3], Sulaiman Sani Kankara[4]
[1,2,3,4] Department of Biological Sciences, Faculty of Natural and Applied Sciences, Umaru Musa Yar'adua University, PMB 2218, Katsina, Nigeria

ABSTRACT

Taxonomic delimitation within the genus *Eriosema* (Fabaceae) in Nigeria has remained poorly resolved due to limited comprehensive revisionary studies and pronounced morphological overlap among species. This study presents the first quantitative taxonomic evaluation of Nigerian *Eriosema* species using numerical (phenetic) approaches to resolve species boundaries and identify diagnostic characters. A total of 55 specimens representing 11 species were collected from natural populations and herbaria, and 17 morphological characters (quantitative and qualitative) were selected following a priori screening. Each specimen was treated as an Operational Taxonomic Unit (OTU) and analyzed using multivariate techniques, including cluster analysis (UPGMA) and principal component analysis (PCA), implemented in PAST after $\log_{10}$ transformation of the data. Cluster analysis separated the specimens into 11 distinct phenetic clusters at a similarity distance of 0.955, with a high cophenetic correlation coefficient (r = 0.84), indicating strong concordance between the similarity matrix and the phenogram. PCA results were congruent with clustering patterns, with the first two principal components explaining 77.3% of total variation. Key characters contributing most to species discrimination were leaflet tip, number of leaflets, leaf type, pod surface, and inflorescence type, while leaflet length, leaflet width, petiole length, and internode were more useful for species delimitation. The results confirm the taxonomic independence of the 11 species and demonstrate the effectiveness of numerical taxonomy in resolving morphological complexity. This study provides a robust framework for future taxonomic revisions of *Eriosema* in Nigeria and contributes significantly to systematic botany and legume biodiversity research.

KEYWORDS: *Eriosema*, Fabaceae, Morphometrics, Species delimitation.

Published online: August 22, 2026

Cite the Article: Habib, A., Bello, A., Lawal, U., Kankara, S.S. (2026). A Quantitative Evaluation of the Taxonomic Revision of Nigerian Eriosema Species through Numerical Approaches. International Journal of Life Science and Agriculture Research, 5(8), 624-640. https://doi.org/10.55677/ijlsar/V05I08Y2026-06

Corresponding Author:
Aliyu Habib

INTRODUCTION

The genus comprises *c*. 150 species and has a pantropical distribution and two centres of diversity, Africa and America. The species occur in tropical savannas and grasslands. They have adapted to these environments by developing specialized underground organs, and an abundance of trichomes (Candido *et al*., 2020). *Eriosema* species are mostly herbs or shrublets with pinnately 3-foliolate leaves, rarely reduced to a single leaflet and possessed 1-2-flowered inflorescences or pedunculate recemes in the leaf axils, yellow to orange, calyx is campanulate, consists of five similar lobes and pods are short and flattened with two seeds.

In Nigeria, *Eriosema* species are important components of savanna and forest ecosystems, supporting biodiversity and ecosystem functions. However, taxonomic research on the genus *Eriosema* remains limited. To date, there has been no taxonomic treatment of the genus, as the species from Nigeria have never been revised. This may explain the taxonomic confusion within the genus. The genus is also somewhat morphologically similar to *Rhynchosia*, although there has been less sampling of the two genera (Kajita *et*

al., 2001; LPWG, 2017). Therefore, updating the nomenclature, classification, description, and identifying useful characters that could help in species identification and delimitation is essential.

Techniques such as clustering and ordination reduce multidimensional data into interpretable patterns, thereby facilitating the identification and delimitation of taxa. Tracing its roots to the principles of Michel Adanson (1763), emphasizing overall similarity and equal weighting of characters, phenetics continues to offer a practical framework for multivariate analyses in taxonomic revisions.

The application of statistical and mathematical techniques to quantify and analyze character state data in organisms involves morphometrics or numerical taxonomy. Despite the increasing use of molecular and phylogenetic tools, morphological characters remain indispensable in taxonomy, as virtually all classification systems are still grounded in principles of morphology. In this context, the external appearance of plants continues to serve as a primary criterion in species delimitation. Numerical taxonomy operates on several key assumptions and philosophical foundations, emphasizing objective and replicable procedures for classification. Importantly, it allows the integration of diverse data sources including morphology, anatomy, cytology, ecology, genetics, physiology, geography, and chemistry into a unified framework. The outcome of this approach is generally regarded as an unbiased representation of similarity or difference among taxa, providing a systematic basis for arranging them hierarchically (Quicke, 1993). In essence, numerical taxonomy relies on the consistent scoring of large numbers of equally weighted characters, grouping taxa according to observable similarities. This methodology has been widely applied in plant taxonomy and remains valuable for interpreting the results of systematic studies (Abu Zaida *et al*., 2008).

MATERIALS AND METHODS

Data and observations were recorded from specimens collected from their natural populations. Herbarium specimens were also included (see table 1).

Study area

Nigeria is located in West Africa, between latitudes 4°N and 14°N and longitudes 3°E and 15°E. The country covers a total area of 923,768 km2 and comprises a vegetation mosaic of tropical and subtropical moist broadleaf forests, grasslands, savannas, and shrublands, flooded grasslands and savannas, montane grasslands and shrublands, and man groves, with a high number of endemics (91 endemic plant species) (Borokini 2014; Dinerstein *et al.* 2017).

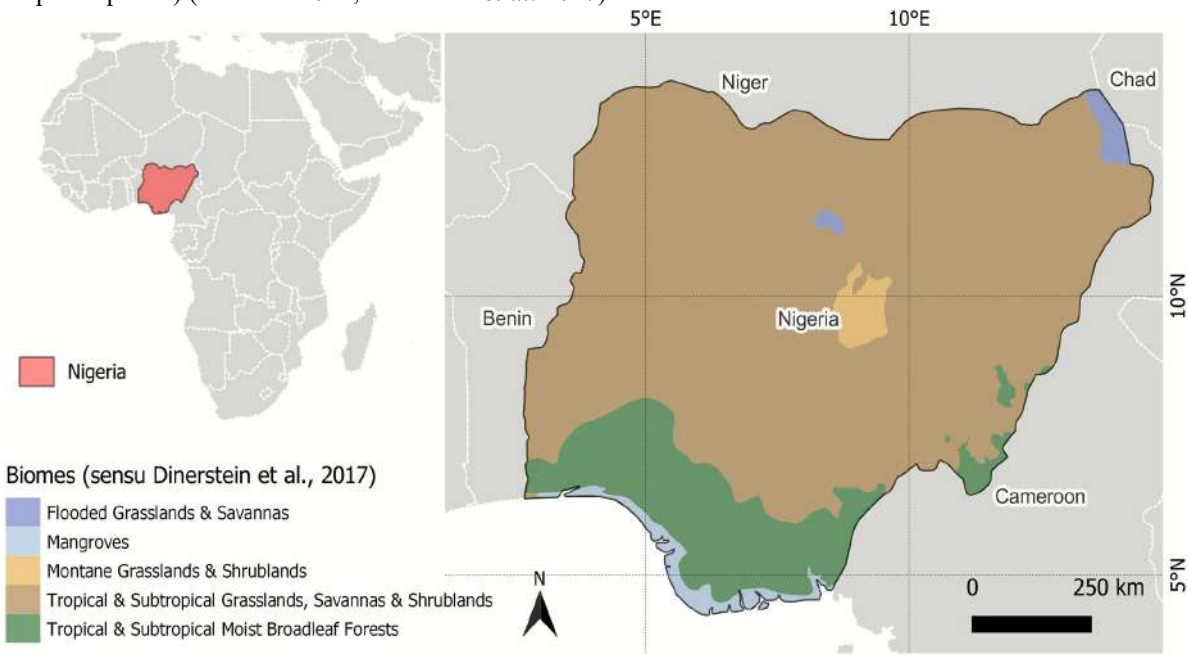


Figure 1: Map of Africa (top left) with Nigeria highlighted in red and an inset of Nigeria (right), showing the geographic distribution of different types of forests, savannas, grasslands, and mangrove biomes (Dinerstein et al. 2017) and its four neighboring countries

Taxa sampling

Specimens were collected and identified using herbarium specimens of Ahmadu Bello University herbarium (ABUH), Forest herbarium Ibadan (FHI), International Legume Database and Information Service (ILDIS); https://www.ildis.org/, online photographs ("African plants - A Photo Guide" (www.africanplants.senckenberg.de) and Flora of West Tropical Africa (FWTA)). A field record of the collected specimens was made, which includes the date of collection, location, collection number, specimen

name, photos, and GPS record. Immediately after collection, the specimens were pressed in the field and, where possible identified. Voucher materials from this study were prepared and deposited in the UMYU herbarium. Duplicates are available for distribution to other herbaria.

A total of 55 specimens (Table 1) from 11 distinct species were used for morphological studies.

Table 1: List of specimens used for the study

S/N	Species	Collector	Collection No	Location
1	*Eriosema laurentii*	Aliyu	AH 101	Yelwa, Taraba State
2	*Eriosema laurentii*	Aliyu		
3	*Eriosema laurentii*	Aliyu		
4	*Eriosema laurentii*	Aliyu		
5	*Eriosema laurentii*	Aliyu		
6	*Eriosema bauchiense*	Aliyu	AH 102	Yelwa, Taraba State
7	*Eriosema bauchiense*	Aliyu		
8	*Eriosema bauchiense*	Aliyu		
9	*Eriosema bauchiense*	Aliyu		
10	*Eriosema bauchiense*	Aliyu		
11	*Eriosema parviflorum*	Aliyu	AH 103	Ngel Nyaki, Taraba State
12	*Eriosema parviflorum*	Aliyu		
13	*Eriosema parviflorum*	Aliyu		
14	*Eriosema parviflorum*	Aliyu		
15	*Eriosema parviflorum*	Aliyu		
16	*Eriosema shirense*	Aliyu	AH 103	Ngel Nyaki, Taraba State
17	*Eriosema shirense*	Aliyu		
18	*Eriosema shirense*	Aliyu		
19	*Eriosema shirense*	Aliyu		
20	*Eriosema shirense*	Aliyu		
21	*Eriosema pulcherrimum*	Aliyu	AH 104	Nguroje, Taraba State
22	*Eriosema pulcherrimum*	Oyewole	1577	Kagoro
23	*Eriosema pulcherrimum*	Baker	407	Kubbani Dam
24	*Eriosema pulcherrimum*	Ohaeri	974	Kubbani village
25	*Eriosema pulcherrimum*	Aliyu		
26	*Eriosema sp*	Aliyu	AH 106	Ngel Nyaki, Taraba State
27	*Eriosema sp*	Aliyu		
28	*Eriosema sp*	Aliyu		
29	*Eriosema sp*	Aliyu		
20	*Eriosema sp*	Aliyu		
31	*Eriosema pellegrinii*	Aliyu	AH 107	Nguroje, Taraba State
32	*Eriosema pellegrinii*	Aliyu		
33	*Eriosema pellegrinii*	Aliyu		
34	*Eriosema pellegrinii*	Aliyu		
35	*Eriosema pellegrinii*	Aliyu		
36	*Eriosema kraussianum*	Aliyu	AH 108	Mambila Plateau, Taraba State
37	*Eriosema kraussianum*	Aliyu		
38	*Eriosema kraussianum*	Aliyu		
39	*Eriosema kraussianum*	Aliyu		
40	*Eriosema kraussianum*	Aliyu		
41	*Eriosema glomeratum*	Aliyu	AH 109	Gashaka, Taraba State
42	*Eriosema glomeratum*	Baker	628	A.B.U Dam Zaria
43	*Eriosema glomeratum*	Enwiogbon		Enugu
44	*Eriosema glomeratum*	Ohaeri		A.B.U Zaria
45	*Eriosema glomeratum*	Aliyu		

46	*Eriosema crinitum*	Aliyu	AH 110	Gashaka, Taraba State
47	*Eriosema crinitum*	Aliyu		
48	*Eriosema crinitum*	Aliyu		
49	*Eriosema crinitum*	Aliyu		
50	*Eriosema crinitum*	Aliyu		
51	*Eriosema griseum*	Aliyu	AH 111	Zaria, Kaduna State
52	*Eriosema griseum*	Aliyu		
53	*Eriosema griseum*	Ohaeri	592	Samaru, Zaria
54	*Eriosema griseum*	Oyewole	1637	Kafanchan
55	*Eriosema griseum*	Oyewole	1613	Birnin Gwari

Morphometric measurements

A total of 55 specimens from the 11 species collected were considered for the morphometric studies (Table 1). More than 25 characters undergo an extensive a priori analysis after which 17 characters were selected for evaluation (Table 2). These include ten (7) quantitative characters, five (10) qualitative characters. In order to eliminate the effects of missing data on the statistical analyses, only specimens that contained all the information needed were selected. For each taxon, at least five specimens were measured. Herbarium specimens were revived by soaking in warm water with a 2-3 drop of soap solution for five minutes before measurements were taken. Measurements were taken using caliper while qualitative characters were coded. The values were obtained by either measuring the quantitative characters or by considering the code given to each qualitative character according to Bello (2015) (Table 2).

Multivariate analyses

Multivariate analyses were carried out by cluster analysis (CA) and principal component analysis (PCA) using PAST 3 program (version 3.05) (Sneath and Sokal, 1973). All the 17 morphological characters for all the 55 specimens were used for the analyses and each individual specimen was considered as an Operational Taxonomic Unit (OTU). For all analyses, the data/values obtained were recorded in a Microsoft excel sheet and then transformed into Log10 in order to standardize the data matrix. Cluster analysis was used to cluster the specimens, as it is better in representing distances among similar specimens (Sneath and Sokal, 1973; Sebola and Balkwill, 2013). The objectives of carrying out cluster analysis was to confirm the distinctness of the species and the principal component analysis was used to determine the characters that are most useful in identification or delimitation of the taxa.

Table 2: Morphometric characters used in the Phenetic analyses *Eriosema* species

S/N	Characters	States/ Codes
1	Leaflet length (LLL)	mm
2	Leaflet width (LLW)	mm
3	Petiole length (PTL)	mm
4	Pedicel length (PDL)	mm
5	Internode (ITN)	mm
6	Number of leaflet (NOL)	no.
7	Number of seed (NOS)	no.
8	Leaflet shape (LLS)	Elliptic=1, linear=2, lanceolate=3, oblanceolate=4 Ovate=5, Oval=6
9	Leaflet tip (LLT)	Acute=1, Aristulate=2 Emarginate=3, Obtuse=4, Rounded=5
10	Leaf type (LTY)	Compound (Unifoliolate)=1, Compound (Trifoliolate)=2, Simple=3
11	Pod shape (PSH)	Flat=1, Oblong=2
12	Pod surface (PSF)	Sparsely pubescent=1, Pubescent=2
13	Flower color (FCL)	Yellow=1, Other=2
14	Inflorescence type (ITY)	Glomerule=1, Raceme=2
15	Stipules (STP)	Present=1, Absent=2
16	Venation (VNT)	Parallel=1, Reticulate=2
17	Phyllotaxy (PLX)	Alternate=1, Opposite=2

RESULTS

Clustering

The cluster analysis of the entire data set separated 55 specimens into 11 clusters (at a similarity distance of 0.955 (Fig. 2). The cophenetic correlation coefficient value of r = 0.84 obtained in the analysis. This indicates a very good fit between the triangular distance matrix and the phenerogam according to Sneath and Sokal (1973). All the groups were recognised as distinct taxa at different taxonomic hierarchies since all their Operational Taxonomic Units (OTUs) did not mix between clusters and considering the level of phenetic distance at which OTUs cluster together. All the *priori* groups formed distinct clusters.

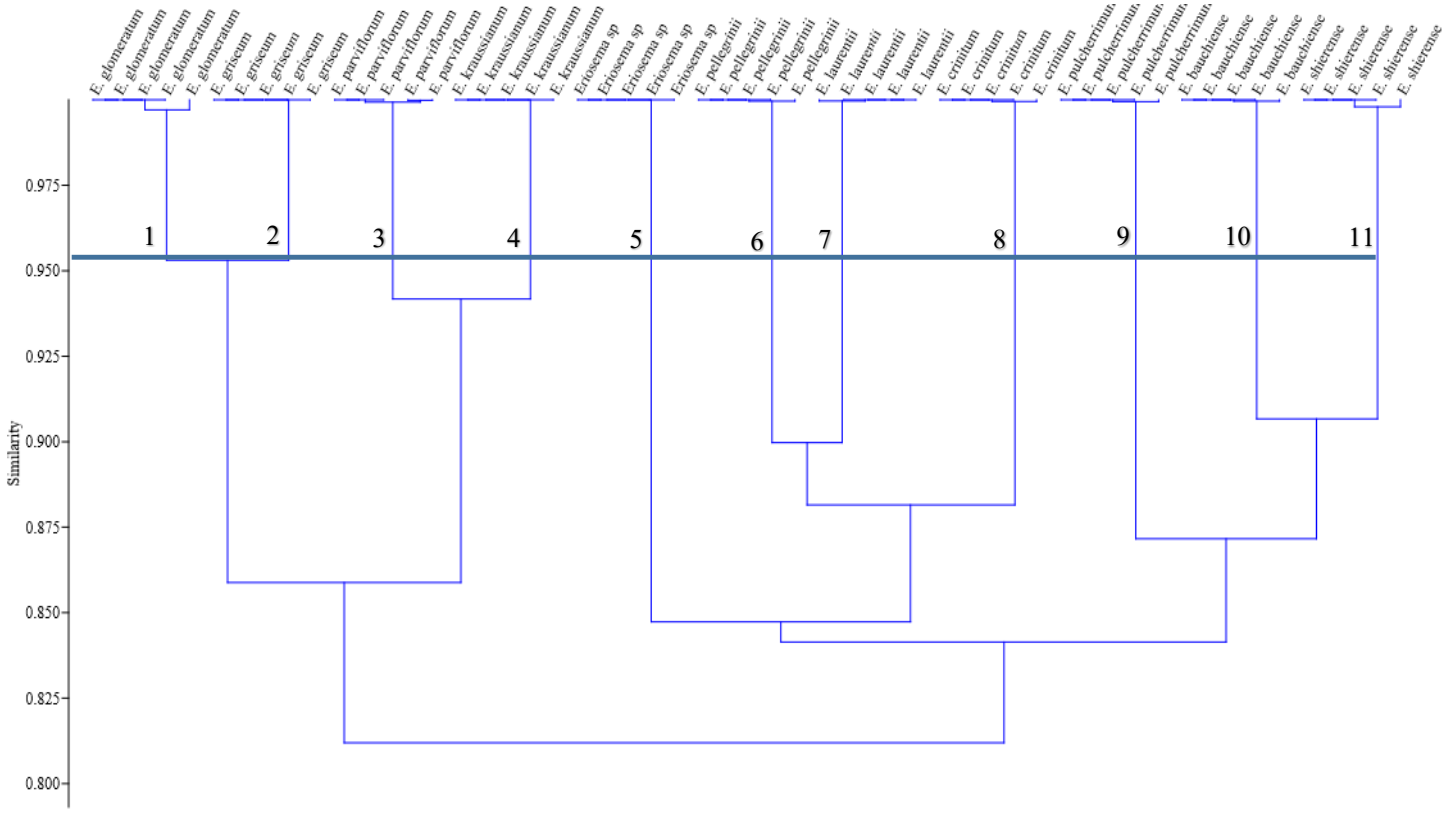


Figure 2. (UPGMA) Phenogram resulting from cluster analysis of the morphological data (at a similarity distance of 0.955). The vertical dark line indicates phenon line. The numbers (1-11) indicate distinct taxa recognisable at species level

Ordination

The ordination analysis of the full data set based on principal component (PCA) also separated the 55 specimens into 11 distinct groups (Fig. 3) corresponding largely to those obtained in the cluster analysis (Figure 2). Principal component 1 accounted for 45.8% of the variation while principal component 2 accounted for 31.5% of variation. The loadings of the first and second PCs are presented in Fig 4 and 5 respectively. The scree plot indicating the contribution of variation of all the PCs was also presented in Fig. 6. The loadings show that characters with the highest contribution of variation among the species are Leaflet tip, Number of leaflet, Leaf type, Pod surface and Inflorescence type; these are more useful in the identification of the species. Characters with the lowest loading include Leaflet length, Leaflet width, Petiole length and Internode, thus can be used in delimiting the species. Eigen values and percentage of variance obtained from the principal component analysis are presented in Table 3.

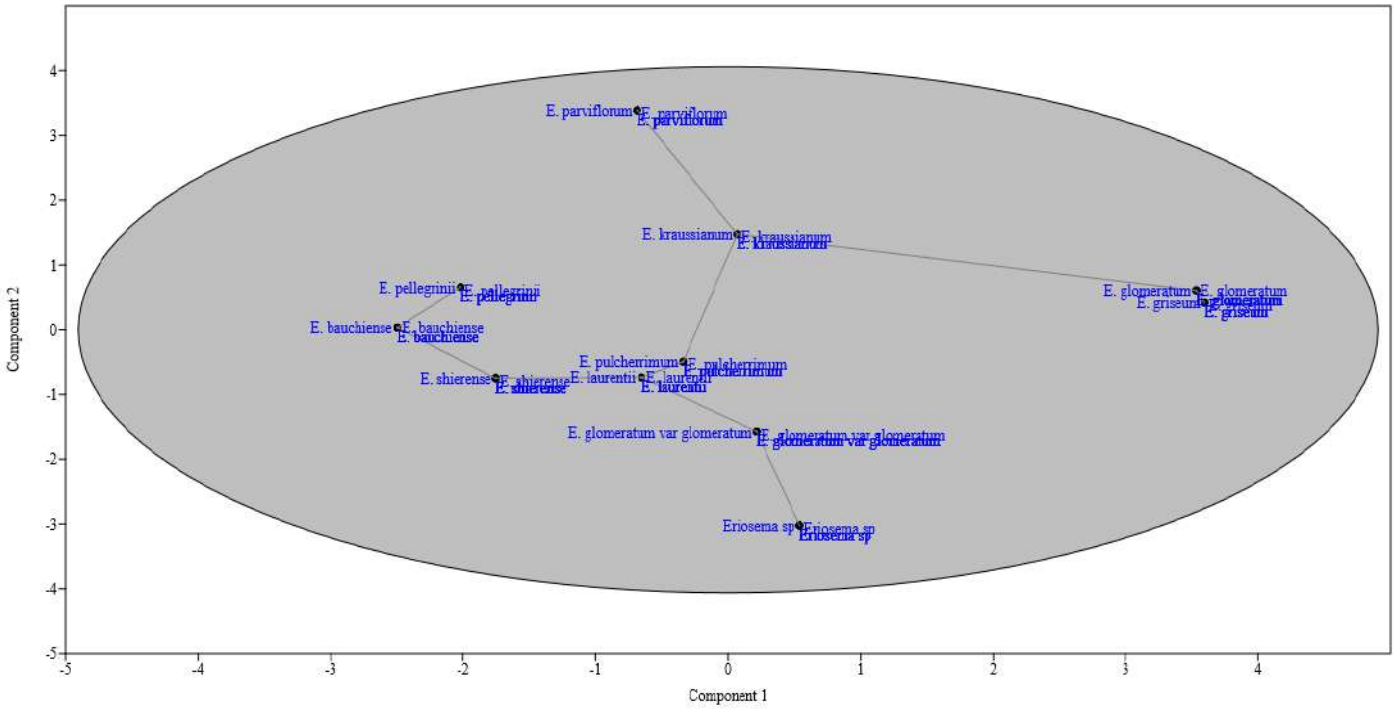


Figure 3. Scatter plot of the principal component analysis (PCA) of morphological variations among the species obtained from the analysis of the morphological data. The circled black dots indicate distinct clusters recognisable at species level

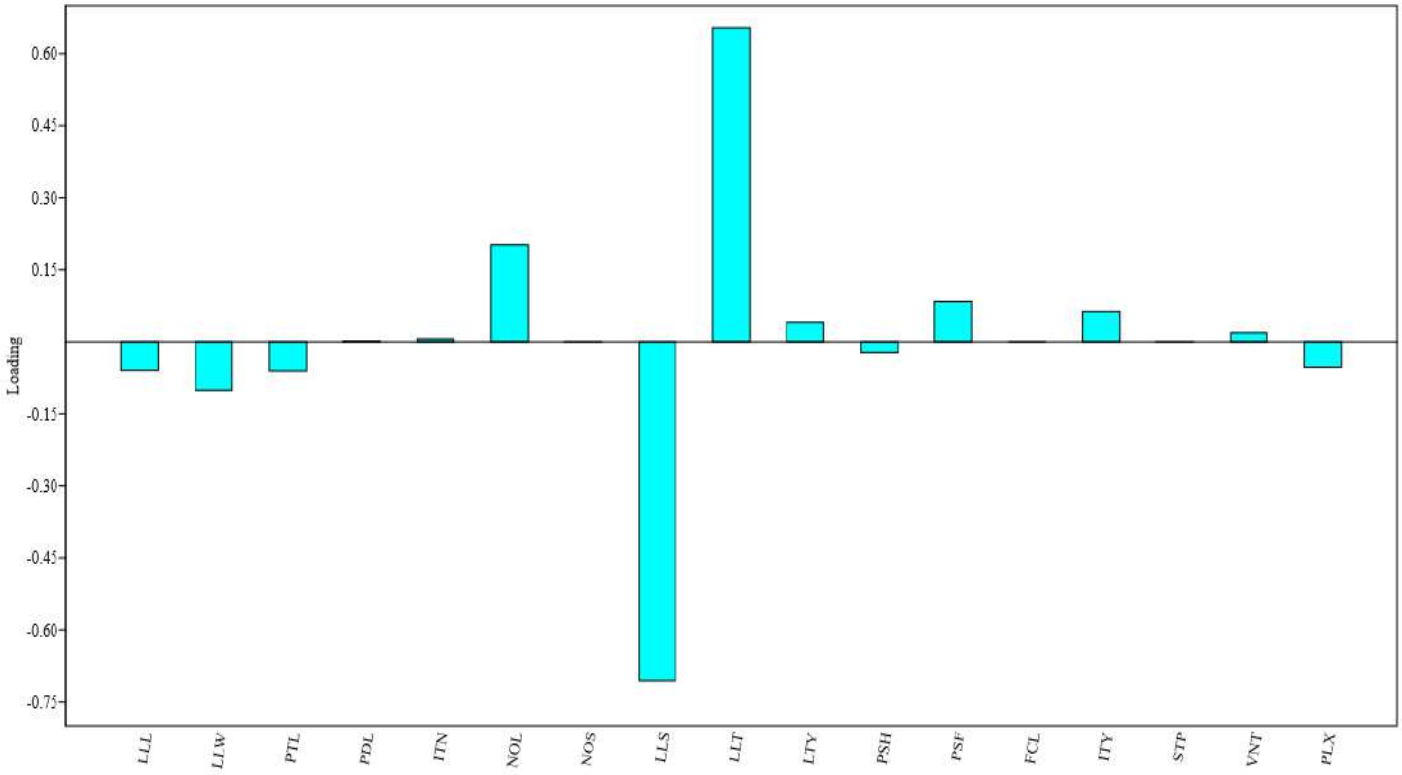


Figure 4: PC1 Loadings indicating morphological characters that have the highest and lowest contributions in the variation among the species

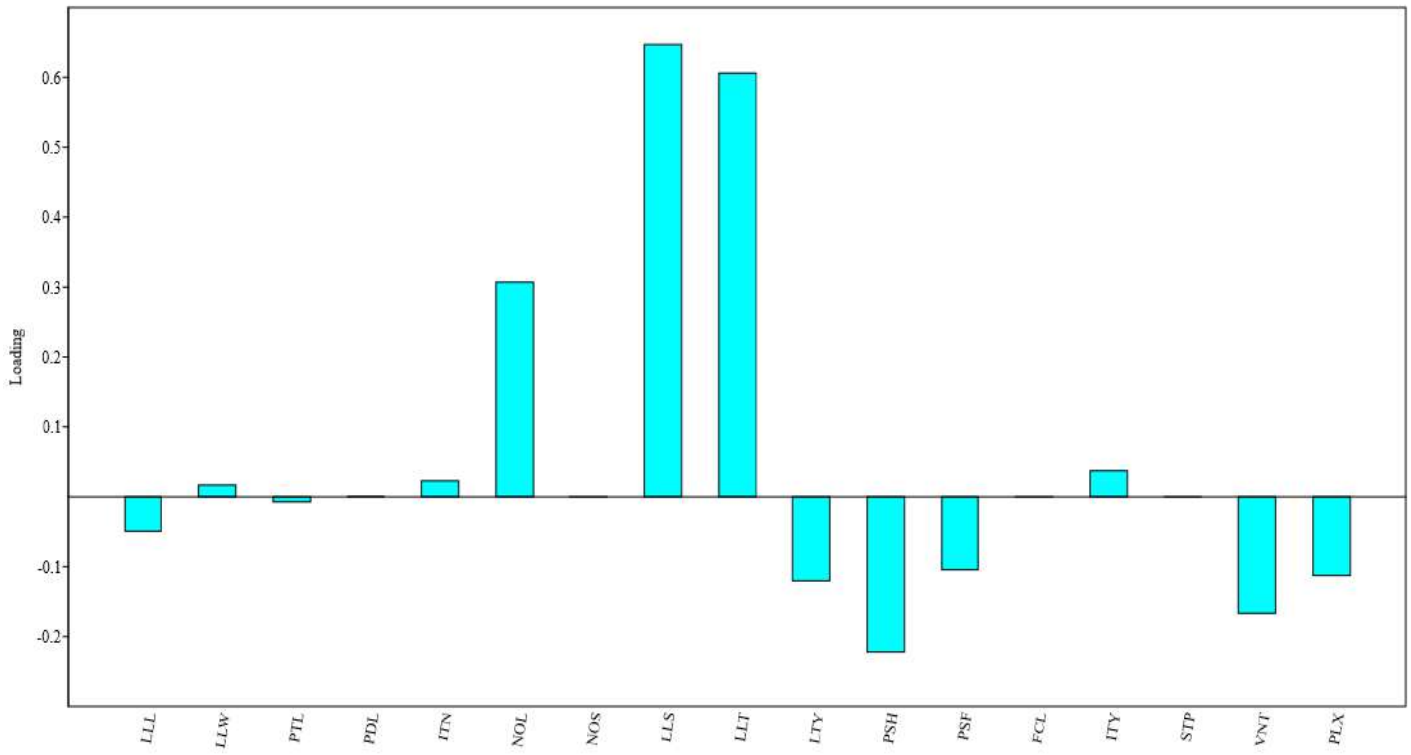


Figure 5: PC1 Loadings indicating morphological characters that have the highest and lowest contributions in the variation among the species

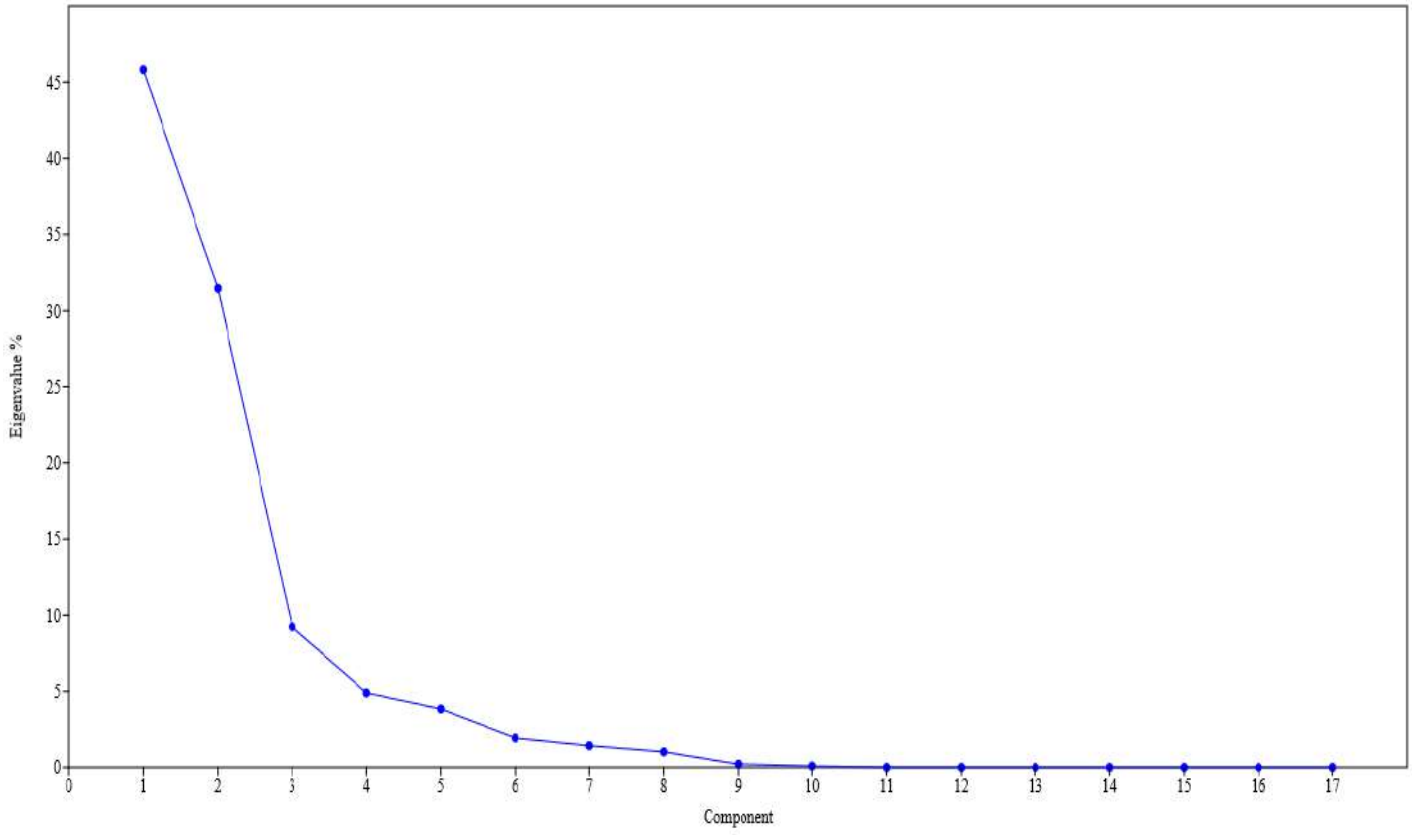


Figure 6: The Scree plot showing axes of Eigen values with percentage of variance and Principal components indicating percentage co components in the variation among the taxa

Table 3. Eigen values and percentage of variance obtained from PCA

PC	Eigen value	% variance
1	3.7164	45.825
2	2.5521	31.469
3	0.749888	9.2466
4	0.39724	4.8982
5	0.311818	3.8449
6	0.157385	1.9407
7	0.116191	1.4327
8	0.083672	1.0317
9	0.0175765	0.21673
10	0.00744092	0.091751
11	0.00014445	0.0017812
12	2.70727E-05	0.00033382
13	1.11182E-05	0.00013709
14	9.99072E-06	0.00012319
15	1.76788E-33	2.1799E-32
16	5.48546E-39	6.7639E-38
17	3.47377E-66	4.2834E-65

DISCUSSION

The objective of this study was to determine the distinctness of the species, similarity distance between the species, and also to identify useful characters that could aid the identification and delimitation of the species. The phenetic species concept states that a species is a set of organisms that are phenotypically similar and that different from other sets of organisms. According to this concept, phenotypic similarity is all that matters in recognizing separate species. Therefore all the 11 distinct clusters/groups are considered as separate species. These species were defined according to Sneath's (1976) concept of "distinct phenetic clusters" and were evaluated according to the pattern of morphological variation. Furthermore, Stace's (1989) criteria for recognizing a species were considered, namely: (i) individuals should bear a close resemblance to one another such that they are always readily recognisable as members of that group; (ii) that there should be gaps between the spectra of variation exhibited by related species; (iii) if there are no such gaps then there is a case for amalgamating the taxa as a single species; and (iv) that each species occupies a definable geographical area and is demonstrably suited to the environmental conditions which it encounters.

Botanists and taxonomists used Multivariate techniques frequently for species identifications and delimitations (e.g. Small and Brookes 1990; Sharma and Pandit 2011; Sebola and Balkwill 2013; Bello *et al*., 2015) to provide faster, more reliable information on taxonomic delimitations. The methods of numerical taxonomy have been used in classifying many plants as well as interpreting results of taxonomic studies (Sneath and Sokal, 1973; Soladoye *et al*., 2008). Thus, Morphometrics add a quantitative element to descriptions, allowing more rigorous comparisons.

In this study, the principal component analysis revealed 11 distinct groups that largely correspond to those obtained in the cluster analysis. Leaflet tip, Number of leaflets, Leaf type, Pod surface and Inflorescence type were found to be the most useful characters in the identification of the species while Leaflet length, Leaflet width, Petiole length and Internode could be used in delimiting the species. These characters can therefore be effectively employed in the taxonomic treatment of other *Eriosema* species that were not included in this study. It is important to note that there is no published work on the multivariate analysis of the genus *Eriosema* and as such no comparison or any scientific argument can so far be made.

CONCLUSION

This study provides the first comprehensive multivariate analysis of the genus *Eriosema* in Nigeria. Using cluster and principal component analyses, 55 specimens representing 11 species were clearly separated into distinct phenetic groups, confirming their taxonomic independence. Key diagnostic traits such as leaflet tip, number of leaflets, leaf type, pod surface, and inflorescence type proved most useful for species identification, while characters like leaflet size, leaflet width, petiole length and internode were effective for species delimitation. These findings not only resolve existing taxonomic ambiguities within Nigerian *Eriosema* but also highlight the value of numerical taxonomy as a reliable tool in systematic botany. The results provide a solid framework for future taxonomic revisions and contribute significantly to understanding the biodiversity of Nigerian legumes.

Taxonomic treatment

Members of this genus are characterised by erect or climbing subshrubs or herbs with unifoliolate or trifoliolate leaves and leaflets that often have small glands underneath and the presence of stipules. The flowers are reflexed, have a 5-lobed calyx, mainly yellow corolla, pubescent pod with two seeds.

Key to the 11 species within the genus *Eriosema*

1a. Leaf simple (entire blade, not divided into distinct leaflets) 2
1b. Leaf compound (blade divided into distinct leaflet(s) 4
2a. Inflorescence a glomerule (clustered heads)..... ***Eriosema shierense***
2b. Inflorescence a raceme (flowers along an axis) .....***Eriosema sp***.
4a. Compound, unifoliolate (single leaflet borne as a "compound" leaf).....5
4b. Compound, trifoliolate (three leaflets) 6
5a. Leaflet lanceolate, tip aristulate (narrow, ending in a small awn); leaflet ~5 × 2 cm; inflorescence raceme ..... ***Eriosema pulcherrimum***
5b. Leaflet ovate, broader (leaflet width ~5 cm); inflorescence glomerule ……...***Eriosema bauchiense***
6a. Inflorescence a glomerule (clustered heads) 7
6b. Inflorescence a raceme (flowers in an elongate cluster)..... 9
7a. Leaflets linear, very narrow (width ≈ 1 cm) …..... ***Eriosema crinitum***
7b. Leaflets not linear (elliptic, ovate or similar)..... 8
8a. Leaflets elliptical to rounded, tip rounded; leaflet length ≈ 5.5 cm ….. ***Eriosema glomeratum***
8b. Leaflets ovate (or ovate–obovate), tip acute; leaflet length larger (≈ 8–9 cm)……. ***Eriosema pellegrinii***
9a. Leaflets very long (leaflet length > 10 cm; lanceolate …….... ***Eriosema laurentii***
9b. Leaflets short to moderate (leaflet length < 10 cm) 10
10a. Leaflet longer, tip emarginate (notched) ..... ***Eriosema kraussianum***
10b. Leaflet shorter, tip not emarginate (rounded or obtuse) 11
11a. Leaflets oval (width ≈ 2–2.5 cm), tip obtuse ..... ***Eriosema parviflorum***
11b. Leaflets elliptical-0blong (width ≈ 1 cm), tip rounded ..... ***Eriosema griseum***

Description of the species

Eriosema laurentii De Wild. in *Miss. Ém. Laurent*: 120 (1905). — Burkill**,** *The Useful Plants of West Tropical Africa*, 2nd ed., Vol. 1: 960 (1985). — Ateba *et al*., *Journal of Ethnopharmacology* 150(1): 298–307 (2013). — Ateba, Njamen, Medjakovic, Zehl, Kaehlig, Jungbauer & Krenn**,** *BMC Complementary and Alternative Medicine* 14: 294 (2014).

A perennial herb, erect, reaching up to 60 cm in height, arising from a woody rootstock with lateral tubers. *Stems* shortly pubescent. *Leaves* typically trifoliolate. *Leaflets* ovate, elliptic, or linear-lanceolate, 21 cm long, glabrous to sparsely hairy. *Petiole* 0.5–1 cm long. *Stipules* green, leaf-like, lanceolate, falcate, 10–21 mm long. *Inflorescences* compact, terminal racemes, 8 cm long. *Peduncle* pubescent, 1–6 cm long. *Flower* keel greenish-yellow; wings brighter yellow. *Fruits* oblong pods, 10–12 mm long, finely pubescent. *Habitat and Ecology:* Occurs in open grasslands, wooded savannas, and rocky hillsides; prefers well-drained sandy or lateritic soils, thriving in moist but not waterlogged conditions.

Etymology: The specific epithet "*laurentii*" was in honor of Jules Laurent who discovered or described the species.

Conservation status: Eriosema laurentii has been evaluated against the five IUCN criteria of threats. It has a very restricted distribution in Nigeria with limited occurrence. Its area of occupancy and extent of occurrence are both below the thresholds, and it is threatened by habitat disturbance from grazing and agricultural expansion. It is therefore assessed as Endangered (EN) (IUCN 2012, B1and B2).

Diagnostic characters: E. laurentii can be dintinguished from other species by its large, sickle-shaped stipules that is conspicuously leaf-like and falcate, and also leaflets that are densely dotted with orange-red glands on both surfaces**.**

Morphology of *Eriosema laurentii.* A=Habit, B=Flower, C=Fruit

Eriosema bauchiense Hutch. & Dalz. in F.W.T.A. 1: 403 (1928); in Bull. Misc. Inform., Kew 1929: 17 (1929). —Haydon in E.G. Baker, Legum. Trop. Africa: 504 (1929). —Hepper in F.W.T.A., ed. 2, 1: 557 (1958). —Verdcourt in F.T.E.A., Leguminosae, Pap.: 791 (1971). —Jacques-Félix in Adansonia, Sér. 2, 11: 182 (1971). —Lock, Leg. Afr. Check-list: 399 (1989). Type from northern Nigeria.

An erect herb reaching 7–42 cm in height, arising from a thick woody rootstock. *Stems* unbranched, 3–6 internodes, dark purplish-brown, nearly glabrous, sparsely pilose. *Leaves* yellow-green. *Leaflets* mostly unifoliolate, 10-13 × 3-5 cm, oblong-elliptic to broadly elliptic, occasionally ciliate veins, midrib beneath. *Petiole* 3 mm long. *Stipule* 5–9 × 2 mm. *Pedicel* 2 mm, sharply deflexed. *Flower* fragrant. *Calyx* 3.5–4 mm, glandular and nearly glabrous. *Pod* 11–16 × 7–10 mm, obliquely oblong, shortly stipitate, hairy. *Seed* purple, 4.5–5.5 × 3 × 1.3 mm, oblong, yellow-brown rim-aril.

Habitat and Ecology: Found on rocky slopes, grassland edges, in open woodlands, and along riverbanks, highly tolerant of periodic fire and grazing.

Etymology: The suffix “ense” is a Latin word meaning origin or association. Thus the specific epithet *bauchiense* is Latinized which indicates the origin of the species from Bauchi state, Nigeria.

Conservation status: Eriosema bauchiense has been assessed against the IUCN criteria. Although recorded from only one site in Taraba State, it is tolerant of fire and grazing and persists in grassland margins and riverbanks. However, its restricted distribution within Nigeria makes it vulnerable to habitat changes. It is therefore assessed as Vulnerable (VU) (IUCN 2012, D2)

Diagnostic characters: E. bauchiense have a sweetly scented flowers, a glabrescent and glandular flowers and obliquely oblong pods, features which are not common in other *Eriosema* species.

Morphology of Eriosema bauchiense. A=Habit, B=Flower, C=Fruit

Eriosema parviflorum E. Mey. In Comm. p. 130 ERIOSEMA podostachyum Hook. f. Fl. Nig. p. 314. Cytisus glomeratus Boj. ! Hort. Maurit. p. 89.

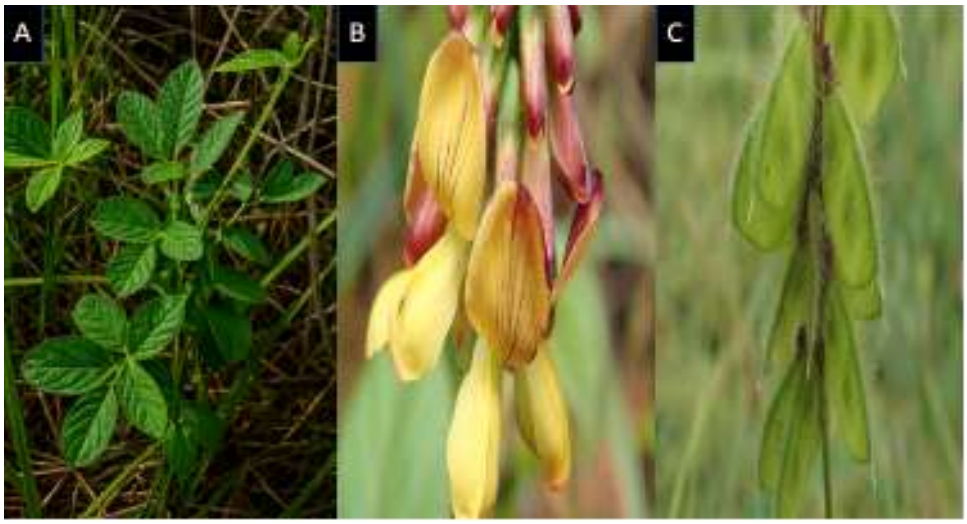
A suffruticose herb, erect or ascending. *Stem* 30–60 cm tall, branched, woody at the base, variably hairy. *Leaves* petiolate, trifoliolate, upper surface pubescent, lower surface paler. *Stipule* narrow, lanceolate, brown, 4–6 mm long, free. *Petiole* 0.5–1 cm long, shorter on lower leaves, longer above. *Leaflets* 3.5–4 cm long, 2–2.5 cm wide, mostly oval or elliptic. *Peduncles* elongate, 7–15 cm long, bearing short racemes, 2.5–4 cm long. *Flower* subsessile, strongly reflexed, 6–7 mm long. *Calyx* short, 2 mm long, pubescent. *Pod* 12 mm long, 7–9 mm wide, densely shaggy with rusty-brown hairs.

Habitat and Ecology: Grows in open savannas and grasslands, as well as in forested mountainous areas with rivers and escarpments, typically on lateritic or sandy soils.

Etymology: The epithet *parviflorum* comes from Latin, *parvus* means "small" and *flos* means "flower," referring to the species' small-sized flowers.

Conservation status: Eriosema parviflorum has been evaluated under the IUCN criteria. With continuing threats from deforestation and habitat fragmentation in its habitat and a highly restricted extent of occurrence and area of occupancy, it is therefore assessed as Endangered (EN) (IUCN 2012, B1).

Diagnostic characters: E. parviflorum is very woody at the base and possess a noticeably small-sized flowers, thicker, narrow black seeds and flowers typically borne in short axillary racemes or 1–2-flowered clusters in leaf axils in contrasts to its congeners that have longer racemes or dense clusters of flower.



Morphology of *Eriosema parviflorum.* A=Habit, B=Flower, C=Fruit

Eriosema shirense Baker f. in Trans. Linn. Soc. London, Bot. 4: 11, t. 2/1–4 (1894); in J. Bot. 33: 147 (1895); in J. Linn. Soc., Bot. 40: 59 (1911). —Haydon in E.G. Baker, Legum. Trop. Africa: 506 (1929). —Staner & De Craene in Ann. Mus. Congo, Bot., Sér. VI, 1, 2: 51, fig. 2, t. 30/4 (1934). —Hauman in F.C.B. 6: 232 (1954). —Hepper in F.W.T.A., ed. 2, 1: 557 (1958). —Mitchell in The Puku 1: 133 (1963). —Torre in C.F.A. 3: 339 (1966). —Verdcourt in F.T.E.A., Leguminosae, Pap.: 798 (1971). —Jacques-Félix in Adansonia, Sér. 2, 11: 183 (1971). —Drummond in Kirkia 8: 220 (1972). —Jacobsen in Kirkia 9: 160 (1973). —Lock, Leg. Afr. Check-list: 406 (1989). —Astle, Phiri & Prince in Kirkia 16: 150 (1998). Type: Malawi, Mt. Zomba, Whyte (BM, lectotype, see note below).

Eriosema filipendulum Welw. ex Baker f. [family LEGUMINOSAE], in J. Bot. 33: 235 (1895). —Haydon in E.G. Baker, Legum. Trop. Africa: 506 (1929). —Torre in C.F.A. 3: 334 (1966). Type from Angola.

A perennial, erect herb developing from a tuberous rootstock, reaching up to 8-35 cm tall. *Leaves* mostly simple. *Leaflets* oblanceolate, hairy, 14 cm long. *Petiole* 10 mm long. *Stipule* narrowly oblong to lanceolate, 21 mm long. *Inflorescence* pseudo-terminal, glomerule, racemes, hairy. *Peduncle* 1.2–14 cm long. *Calyx* densely hairy. *Petal* cream-coloured, externally veined, reddish to brown, often more yellow on the inner side, wings yellow, keel greenish. *Pod* oblong-elliptic, 1–1.3 cm long, covered with long rust-coloured hairs.

Habitat and Ecology: Inhabits montane grasslands and upland slopes; commonly occurs on grassy hillsides with steep valleys and gorges, often near forest margins.

Etymology: The specific epithet *shirense* indicates that the species was originated and first described from the samples collected in the Shire Highlands region of southern Malawi

Conservation status: Eriosema shirense has been assessed under the five IUCN criteria. Its area of occupancy is very small and threats from fire and agriculture. It is therefore assessed as Endangered (EN) (IUCN 2012, B1).

Diagnostic characters: The only species to have arises from a globose tuberous rootstock with flowers borne in upper-axillary or pseudo-terminal racemes on a ridged, hairy peduncle and long spreading hairs on leaflet margins.

Morphology of *Eriosema shirense.* A=Habit, B=Flower, C=Fruit

***Eriosema pulcherrimum* Taub.** in E. & P. Pflanzenfam. 3, 3: 375 (1894).

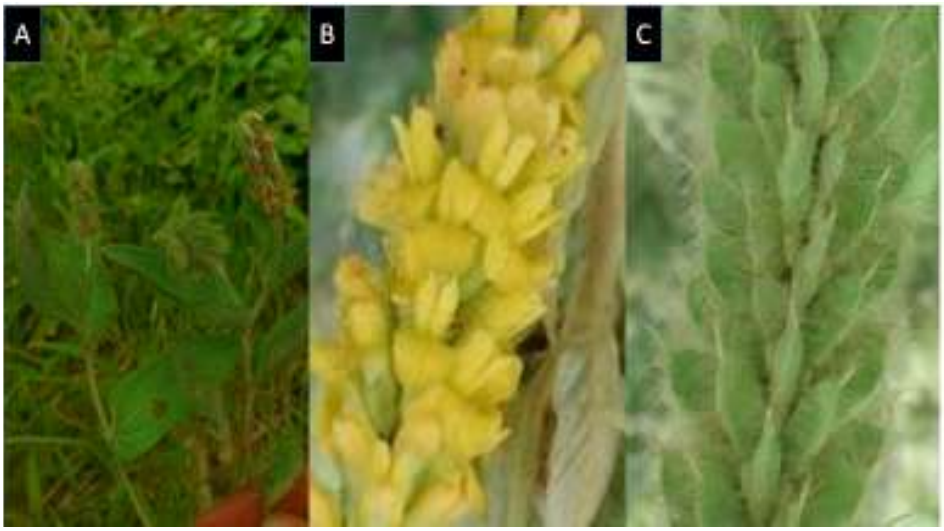
An upright herb, 30–60 cm tall, arising from a woody, often tuberous rootstock. *Stems* angular, clothed in soft, woolly white to silvery hairs. *Leaves* unifoliolate. *Stipule* lanceolate, hairy. *Leaflets* oval to elliptic, mosly lanceolate, 5–8 × 2–5 cm, venation conspicuous, well developed. *Inflorescence* a dense racemes, terminal, axillary, borne on angular peduncles. *Bracts* narrow, pointed, furnished with long white hairs. *Calyx* campanulate, hairy. *Corolla* violet to purple, hairy externally, Wings and Keel pubescent. *Pod* oblong, about 10 × 7–8 mm, densely hairy. *Seed* oblong, compressed, 5 × 1.5 mm, with a pale yellowish hilum.

Habitat and Ecology: Mostly found in open rocky savannas, grasslands, and fallows; also found on rolling hills and deep gorges with flowing rivers and streams.

Etymology: The specific epithet *pulcherrimum* comes from Latin, meaning "most beautiful," referring to the plant's striking and attractive flowers.

Conservation status: Eriosema pulcherrimum has been examined against the IUCN criteria. Although its range in Nigeria is restricted, the habitats are relatively stable and the species are not facing any threat, it is therefore assessed as Vulnerable (VU) (IUCN 2012, D2).

Diagnostic characters: E. pulcherrimum is distinct due to its soft white-tomentose/woolly hairs with leaves often fold over a short axillary raceme and flowers borne in compact racemes.



Morphology of *Eriosema shirense.* A=Habit, B=Flower, C=Fruit

Eriosema sp.

An erect perennial herb or subshrub, arising from a woody rootstock, sparingly branched. *Stem* slender, cylindrical, green to purplish-brown, finely pubescent, young stems hairy older stems slightly woody at the base. *Leaves* simple, alternate. *Stipule* narrow,

hairy. *Petiole* **s**hort, densely hairy. *Leaflet**s*** elliptical, margins entire, apex acute, venation prominent beneath. *Inflorescence* axillary, terminal, short racemes. *Flower* papilionaceous, bright yellow sometimes orange-yellow, 1–2 cm long. *Corolla* broad, wings and keel shorter. *Calyx* campanulate, pubescent. *Pod* oblong, 1–2 seeded, 1–2 cm long. *Seed* smooth, brown-blackish with hard and shiny coat.

Habitat and Ecology: Occurs on sub-montane forests, open woodlands, and the edges of grasslands with tall emergent trees.

Conservation status: the species has been evaluated, but the available data on its population size, distribution, and threats are insufficient to make an accurate assessment. It is therefore assessed as Data Deficient (DD).

Diagnostic characters: The simple, opposite leaves combined with bright yellow-orange papilionaceous flowers in short racemes make *Eriosema sp.* distinct from other species.

Morphology of *Eriosema sp.* A=Habit, B=Flower

Eriosema pellegrinii Tisser. in *Bull. Mus. Natl. Hist. Nat.*, sér. II, vol. 2: 316 (1930).

An erect, perennial herb or subshrub, 40–80 cm tall. *Stem* Slender, woody at the base, covered with spreading rusty to brownish hairs. *Leaves* trifoliolate. *Leaflets* ovate, 7-8.5 cm long**,** 3.5-4.5 cm wide. *Stipule* narrow, brownish, hairy. *Petiole* Short, hairy. *Inflorescence* often glomerule, shortly racemose. *Peduncle* short, hairy. *Flower* typically papilionoid. *Corolla* bright yellow**,** wings and keel narrow. *Calyx* Small, silky, and ciliate. *Pod* somewhat flattened, 10–15 mm long**,** 6–8 mm wide. *Seed* flattened, 4–6 mm long**,** brownish to dark.

Habitat and Ecology: Prefers open shrubland within savanna, with scattered woody vegetation on rocky or sandy soils; well adapted to drought and seasonal fires.

Etymology: The specific epithet *pellegrinii* is Latinized in honour of Francois Pellegrin due to his immense work and contribution to the Flora of tropical Africa.

Conservation status: Eriosema pellegrinii has been assessed under the IUCN criteria. Its distributional range is limited and though adapted to fire and drought, its restricted range makes it vulnerable to habitat alteration. It is therefore assessed as Vulnerable (VU) (IUCN 2012, D2).

Diagnostic characters: E. pellegrinii is unbranched, woody-rooted herb with glabrescent stem when fully matured (hairy only when young) in contrasts to other *Eriosema* species that retain their dense hairy nature and possess a dense, many-flowered axillary clusters.

Morphology of *Eriosema pellegriniii.* A=Habit, B=Flower, C=Fruit

Eriosema kraussianum Meisn. in *London Journal of Botany* **2**: 91 (1843). —Harv. in *Flora Capensis* **2** (1862). —Bews, *Flora of Natal and Zululand* (1921). —Ross in *Bothalia* (1972). Type: South Africa, KwaZulu-Natal, Port Natal (Durban), **Krauss s.n.** (isotype: MEL 302765).

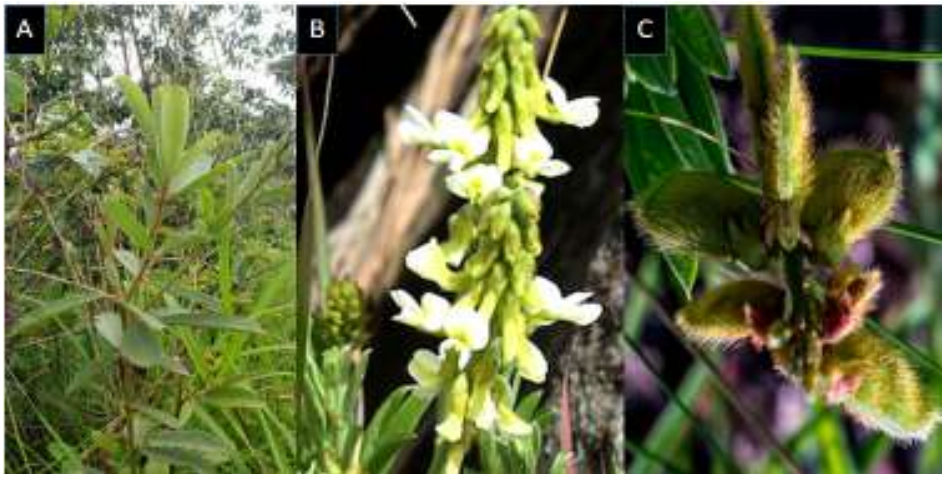
A small, upright, perennial herb growing in clumps, reaching about 150 mm in height. *Stems* unbranched, densely clothed with distinctive, silky, silvery hairs. *Leaves* borne on short stalks. *Leaflets* 7-10 cm long, prominent venation. *Inflorescence* a racemes, 35 mm high. *Flower* pale yellow to creamy white, 7 mm long. *Fruit* somewhat flattened, hairy pod, 15 × 8 mm in size.

Habitat and Ecology: Occurs in grasslands and on rocky hill slopes, often in shallow soils supporting diverse plant communities ranging from algae, ferns, and herbs to climbers, lianas, and various trees.

Etymology: The species derived its name in honour of Christian Ferdinand Friedrich von Krauss, who first collected the plant in the KwaZulu-Natal region of South Africa, hence the specific epithet *kraussianum.*

Conservation status: Eriosema kraussianum has been evaluated against the IUCN criteria. Having occupy a wide distribution but with a habitat prone to deforestation and fires, it therefore assessed as Near Threatened (NT).

Diagnostic characters: A tufted, perennial herb having pale yellow flower and a decumbent, distinctly ribbed, silvery stem with silky hairs. This silky indumentum on stems is very noticeable and a distinct character of *E. kraussianum.*



Morphology of *Eriosema kraussianum.* A=Habit, B=Flower, C=Fruit

Eriosema glomeratum (Guill. & Perr.) Hook. f. in W. J. Hooker, *Niger Fl.*: 313 (1849). —Baker f. in *Flora of Tropical Africa*, Vol. 2: 228 (1871). —"Legum. Trop. Afr." (E. G. Baker) 2: 511 (1871). —[van der Maesen & Wieringa in *Blumea*] *notes on West African plants* (2012). Type (basionym): *Rhynchosia glomerata* Guill. & Perr. in *Fl. Seneg. Tent.*: 216 (1832).

An erect, much-branched shrub, 5–6 ft in height, with slender woody branchlets densely covered with rusty-brown hairs. *Stipule* lanceolate, papery, 6 mm long. *Leaves* nearly sessile. *Leaflets* trifoliolate, mostly linear, oblong-lanceolate, 8 cm long, somewhat leathery, grey-green, finely pubescent. *Pedicel* 2 mm long. *Flower* densely, nearly sessile with axillary head. *Bract* linear, 6 mm long. *Calyx* densely silky, teeth long, slender, ciliate. *Corolla* bright yellow, twice the length of the calyx. *Pod* broad-oblong, 12 mm long, 6 mm wide, densely clothed with long silky hairs.

Habitat and Ecology: Grows in cool to warm highlands, on rolling hills with lush landscapes dominated by low grasses.
Etymology: The specific epithet *glomeratum* is a Latin word, meaning "clustered" referring to the rounded, clustered flowers of this species.
Conservation status: Eriosema glomeratum has been evaluated against the IUCN criteria. With a restricted distribution, susceptibility to habitat disturbance and only known in few localities, it is therefore assessed as Vulnerable (VU) (IUCN 2012, D2).
Diagnostic characters: E. glomeratum have a distinct flowers borne on a nearly sessile axillary head, papery stipules and a stems covered with a rusty to brownish hairs (ferruginous pubescence). This dense, spreading hairs is a distinguishing feature from species with glabrous or sparsely hairy stems.

Morphology of *Eriosema glomeratum.* A=Habit, B=Flower, C=Fruit

Eriosema crinitum (Kunth) G. Don in Gen. Hist. 2: 348 (1832)
A subshrub up to 1 m high. *Stem* erect, sometimes trailing, clothed with hairs. *Root* stout taproot. *Stipule* ovate-lanceolate, 5–6 × 2 mm, externally pubescent. *Leaves* petiolate, hairy. *Leaflets* trifoliolate, 5-6 x 1.5 cm long, elliptical. *Inflorescence* globose racemes, 2–3 cm long. *Peduncle* sturdy, 4.5–7 mm long, hairy. *Bract* 3–5 × 1 mm, hairy. *Flower* pedicelate, 2 mm long. *Calyx* bilabiate, yellowish, hairy. *Corolla* yellow, pubescent, wings 6–8 mm long, keel slightly shorter. *Pod* obovoid flattened, 10–13 × 6–7 mm, two seeded, silky, hairy. *Seed* ellipsoid, 4 × 3 mm, brown-grey.
Habitat and Ecology: Typically found at woodland margins, in open grasslands, or within thickets, favoring sandy or lateritic soils.
Etymology: The specific epithet *crinitum* refer to the latin word for "hairy" or "hirsute" describing the plant's hairy appearance
Conservation status: Eriosema crinitum has been assessed using the IUCN framework. It has limited distribution and faces local habitat disturbance. It is therefore assessed as Vulnerable (VU) (IUCN 2012, D2).
Diagnostic characters: E. crinitum possess a distinct flowers borne on a nearly sessile axillary head, stipules not papery, and a stems covered with a rusty to brownish hairs (ferruginous pubescence). This dense, spreading hairs is a distinguishing feature from species with glabrous or sparsely hairy stems.

Morphology of *Eriosema crinitum* A=Habit, B=Flower, C=Fruit

Eriosema griseum Baker. in *Fl. Trop. Afr.* 2: 228 (1871). Type: Angola, collected by F. J. Welwitsch, specimen no. 4106 (BM, holotype).

A low, much-branched shrub with slender, firm, woody branchlets densely covered in grey pubescence. *Leaflets* trifoliolate, elliptical-oblanceolate, 3.5–4 cm long, 1 cm wide, apex rounded-acute, finely pubescent. *Stipule* 6 mm long, lanceolate, thin and papery. *Petiole* short, 3 mm long. *Pedicel* very short, 2-3 mm. *Flower* borne in clusters. *Bract* lanceolate-acuminate, grey-silky, 9–12 mm long. *Calyx* linear to lanceolate, densely ciliate, *Corolla* yellow. *Pod* oblong, finely pubescent.

Habitat and Ecology: Common in savanna shrublands, especially on dry, rocky slopes with nutrient-poor soils.

Etymology: The specific epithet *griseum*, a Latin word meaning "grey" describing the plant's distinct grey hairs clothing its body.

Conservation status: Eriosema griseum has been assessed under the IUCN criteria. Its known distribution is very limited and vulnerable to over grazing and land use. It is therefore assessed as Vulnerable (VU) (IUCN 2012, D2).

Diagnostic characters: A subshrub forming a cluster of stems that arise from a thick, woody rootstock and branching from the base with a dense greyish indumentum on stems and undersides of the leaves.

Morphology of *Eriosema griseum.* A=Habit, B=Flower, C=Fruit

REFERENCES

1. Abu Ziada, M. E., Mashaly, I. A., and Torky, M. (2008). Ecological studies on the aquatic vegetation in north-east Nile Delta. *International Journal of Botany*, *4*(2), 151-163.
2. Adanson, M. (1763). FAMILLES. *Plantes. II. Partie. Paris*, 356.
3. Bello, A. (2016). Taxonomy and evolutionary studies on the genus Psoralea L.(Psoraleeae, Fabaceae).
4. Cândido, E.S., Vatanparast, M., de Vargas, W., Bezerra, L.M.P.A., Lewis, G.P., Mansano, V.F., *et al.* (2020). Molecular phylogenetic insights into the evolution of *Eriosema* (Fabaceae): a recent tropical savanna-adapted genus, *Botanical Journal of the Linnean Society*, 194 (4), 439–459. https://doi.org/10.1093/botlinnean/boaa059
5. Dinerstein, E., Olson, D., Joshi, A., Vynne, C., Burgess, N. D., Wikramanayake, E. and Saleem, M. (2017). An ecoregion-based approach to protecting half the terrestrial realm. *BioScience*, *67*(6), 534-545.
6. Kajita, T., Ohashi, H., Tateishi, Y., Bailey, C. D., and Doyle, J. J. (2001). rbcL and legume phylogeny, with particular reference to Phaseoleae, Millettieae, and allies. *Systematic Botany*, 515-536.
7. Quicke, D. J., and Ingram, S. N. (1993). Braconine wasps of Australia. *Memoirs of the Queensland Museum, Nature*, *33*(1), 299-332.
8. Quike, D. L. J., (1993). Principles and Techniques of Contemporary Taxonomy (Tertiary Level Biology). 1st Edn., *Kluwer Academic Publishers Norwell, New York,* ISBN-10: 0751400203, Pages: 328.
9. Sebola, R. J., and Balkwill, K. (2013). Calibration, verification and stepwise analysis for numerical phenetics: Olinia (Oliniaceae) as an example. *South African Journal of Botany*, *88*, 42-55.
10. Sharma, S. K., and Pandit, M. K. (2011). A morphometric analysis and taxonomic study of Panax bipinnatifidus Seem.(Araliaceae) species complex from Sikkim Himalaya, India. *Plant systematics and evolution*, *297*(1), 87.
11. Small, E., and Brookes, B. (1990). A numerical taxonomic analysis of the Medicago littoralis–M. truncatula complex. *Canadian journal of botany*, *68*(8), 1667-1674.
12. Sneath, P. H. A. (1973). The principles and practice of numerical classification. *Numerical taxonomy*, *573*.
13. Sneath, P. H. A. (1976). Phenetic taxonomy at the species level and above. *Taxon*, *25*(4), 437-450.
14. Soladoye, M. O., Sonibare, M. A., and Rosanwo, T. O. (2008). Phytochemical and morphometric analysis of the genus Acalypha Linn. (Euphorbiaceae). *J. Applied. Sci*., 8: 3044-3049.

15. Stace, C. A. (1989). *Plant taxonomy and biosystematics*. Cambridge University Press.
16. The Legume Phylogeny Working Group (LPWG, 2017). A new subfamily classification of the Leguminosae based on taxonomically comprehensive phylogeny. Taxon 66: 44-77