



Morphological Characterization of Four Indigenous Species of The Family Asteraceae and Their Taxonomic Relationships

By

Onyekachi Uju Tilda¹

¹Department of Plant Science & Biotechnology Imo State University Owerri, Imo State Nigeria



Article History

Received: 25/09/2026

Accepted: 01/10/2026

Published: 03/10/2026

Vol – 5 Issue –10

PP: - 09-17

Abstract

This study investigated the morphological character of four selected species of the family Asteraceae—*Vernonia amygdalina*, *Chromolaena odorata*, *Emilia coccinea*, and *Synedrella nodiflora*—with the aim of elucidating their taxonomic relationships using diagnostic features. Morphological characterization was conducted using intangible and tangible traits of vegetative and reproductive structures, including stem, leaf, inflorescence, fruit, and seed features, following standard taxonomic procedures. Results obtained revealed significant variation in morphological feature of the species Asteraceae investigated. Quantitative measurement of the species revealed that *Vernonia amygdalina* recorded the highest leaf length (12.5 ± 1.2 cm), Leaf width (4.5 ± 0.4 cm) and Petiole length (2.5 ± 0.2 cm) while the least was obtained from *Synedrella Nodiflora* (5.5 ± 0.6 cm; 3.2 ± 0.4 cm; and 1.3 ± 0.2 cm). Comparative morphological analysis of *Vernonia amygdalina*, *Chromolaena odorata*, *Emilia coccinea*, and *Synedrella nodiflora* revealed both similarities and notable differences among the species. *Vernonia amygdalina* and *Chromolaena odorata* shared similarities in leaf morphology, stem characteristics, and inflorescence structure. *Emilia coccinea* displayed intermediate morphological features, while *Synedrella nodiflora* was distinct, with narrower leaves, reduced pubescence, and smaller capitula. A dichotomous key was constructed to facilitate identification of the species, and a cladogram based on combined morphological and chemical characters illustrated their taxonomic relationships. The findings demonstrate that integrating morphological data provides a reliable framework for species delimitation and understanding evolutionary relationships within the Asteraceae. The close affinity between *V. amygdalina* and *C. odorata*, the intermediate position of *E. coccinea*, and the distinct nature of *S. nodiflora* highlight the effectiveness of this combined approach.

Keywords: Morphology, Characterization, *Vernonia amygdalina*, *Chromolaena odorata*, *Emilia coccinea*, and *Synedrella nodiflora* Family, Asteraceae, Taxonomic Relationships.

Introduction

Asteraceae has been studied worldwide from the botanical and chemical standpoints [1]. Controversies about phylogeny and affinity of infra-familial groups as well as uncertain positioning of some genera are still considerable. However, few studies have attempted to reveal the relationship between metabolite differences and bioactivity in diverse plant species [2].

Despite extensive research on some members of the Asteraceae, many species of ecological, medicinal, and economic relevance remained underexplored [3]. Their phytochemical potential and taxonomic relationships are yet to be comprehensively understood, limiting the effective utilization of their bioactive compounds in medicine,

pharmaceutical development, food processing, and cosmetic industries. Furthermore, the family Asteraceae is characterized by high morphological diversity, which often results in taxonomic complexities due to phenotypic plasticity, convergent evolution, and hybridization. These factors frequently obscure species boundaries and complicate classification based solely on morphology [4].

Synedrella nodiflora, *Emilia coccinea*, *Chromolaena odorata* and *Vernonia amygdalina* are among the exotic breeds domesticated and cultivated within our tropical rain forest belt, mostly for economic and medicinal values [5].

Traditional plant taxonomy has historically relied on morphological features such as leaf shape, inflorescence type, and floral structure. However, these traits are often influenced

by environmental factors, leading to difficulties in accurately identifying and distinguishing species [6].

The lack of integrative studies combining morphological and chemotaxonomic data exacerbates these issues, particularly in regions with limited taxonomic resources.

Phenotypic plasticity, convergent evolution, and hybridization are particularly problematic in morphologically diverse families like Asteraceae [7]. Hence, the need for a combination of chemotaxonomic and morphological characterization of the four species under study to improve classification reliability and provide a strong basis for establishment of relatedness of the four selected species of the Asteraceae family under investigation [8].

This study addresses this gap by using a dual approach (chemotaxonomic and morphological characterization) to establish the relationships among the selected Asteraceae species, aiming at highlighting their taxonomic similarities and differences.

The chemotaxonomic approach is expected to provide information on the chemical constituents and trace evolutionary trends. This is expected to obliterate the blurred morphological instability among the four Asteraceae species investigated [9].

Plant species exhibit varying degrees of morphological and phytochemical diversity, which play significant roles in their taxonomy, evolution, and ecological adaptation. Previous studies have demonstrated that variability within and among plant species can be considerable, particularly in large and morphologically complex families such as the Asteraceae [10]. The synthesis and accumulation of secondary metabolites in plants are largely influenced by genetic factors, although environmental conditions may also contribute to variations in chemical profiles [11]. Consequently, phytochemical composition has increasingly been recognized as a reliable tool in plant systematics, providing chemotaxonomic markers that complement traditional morphological classification.

Despite extensive research on some members of the Asteraceae, many species of ecological, medicinal, and economic relevance remained underexplored. Their phytochemical potential and taxonomic relationships are yet to be comprehensively understood, limiting the effective utilization of their bioactive compounds in medicine, pharmaceutical development, food processing, and cosmetic industries.

An integrative approach that combines morphological and chemotaxonomic data has been recommended as a more robust framework for species delimitation and phylogenetic inference within complex plant groups. However, there remains a paucity of studies that integrate these methods, particularly for the four selected Asteraceae species under

investigation (*Emilia coccinea*, *Chromolaena odorata*, *Vernonia amygdalina*, and *Synedrella nodiflora*). The absence of comprehensive comparative analyses limits the understanding of their taxonomic relationships and evolutionary divergence [12].

To the best of the researcher's knowledge, most taxonomists use only one line of evidence in their taxonomic studies [4]. Thus, a combination of morphological relationship in the investigated Asteraceae species is very scarce hence the need for this research interest of investigating these two lines of evidence for the four species.

Therefore, this study is justified by the need to bridge this knowledge gap through a combined morphological and chemotaxonomic characterization of the selected species. By integrating structural and phytochemical evidences, the research aims to provide reliable taxonomic data, improve species identification, and contribute to a clearer understanding of their systematic placement within Asteraceae.

Materials and methods

Study Area

The study was conducted in Owerri cosmopolitan zone of **Imo State, Nigeria**, which includes **FUTO, Ihiagwa (Owerri West LGA), Egbu (Owerri North LGA), Akwakuma, and Alvan Ikoku area (Owerri Municipal LGA)**. These sites represented a gradient of **urban to peri-urban vegetation** with diverse ecological conditions ranging from secondary forest edges and open grasslands to roadside vegetation. The area lies within the **humid tropical rainforest belt** of southeastern Nigeria, characterized by annual rainfall between 2,000–2,500 mm and mean temperatures of 25–30°C. This region supports a wide range of **herbaceous and shrubby Asteraceae species**, providing an ideal setting for taxonomic and chemotaxonomic evaluation.

Plant Collection and Identification

Fresh and healthy specimens of *Vernonia amygdalina* (Delile), *Chromolaena odorata* (L.) R.M. King & H. Rob., *Emilia coccinea* (Sims), and *Synedrella nodiflora* (L.) Gaertn were collected from the aforementioned sites between **March and May 2025**. The plants were **carefully uprooted**, cleaned, and labeled with collection numbers indicating their locality.

Preliminary identification was done using **Flora of West Tropical Africa (Hutchinson and Dalziel, 1954–1972)** and confirmed at the **Imo State University Herbarium** by comparison with authenticated specimens. Voucher samples were prepared and deposited at the IMSU Herbarium for reference. The Botanical Name, Common Name, Location and Coordinates of the four species is shown in Table 1.

Table 1. Location of the four medicinal plant species and their coordinates

Botanical Name	Common Name	Location	Coordinates
<i>Chromolaena odorata</i>	Siam weed	FUTO Demonstration Garden	5° 30 ^I 26.8183 ^{II} N Lat 7° 02 ^I 27.5487 ^{II} E Log
<i>Emilia coccinea</i> (Sims),	Scarlet tassel flower	Egbu	5° 25 ^I 24 ^{II} N Lat 7° 43 ^I 27 ^{II} E Log
<i>Synedrella nodiflora</i> (L.) Gaertn	Nodeweed	Akwakuma	5° 25 ^I 25 ^{II} N Lat 7° 43 ^I 26 ^{II} E Log
<i>Vernonia amygdalina</i> (Delile),	bitter leaf	Alvan	5° 28 ^I 55 ^{II} N Lat 7° 04 ^I 04 ^{II} E Log

Plate 1: Samples of *Synedrella nodiflora* (L.) in the laboratoryPlate 2: Plate 3.1: Samples of *Vernonia amygdalina* (Delile), *Chromolaena odorata* (L.) R.M. King & H. Rob., *Emilia coccinea* (Sims) in the laboratory

Morphological

Morphological characterization focused on qualitative and quantitative traits of vegetative and reproductive structures, following standard procedures in plant taxonomy (Radford, 1984; Harborne, 1998; Stuessy, 2009). The traits recorded included:

1. **Stem Characteristics** – Observations on stem color, texture, pubescence, branching pattern, and cross-sectional structure. Measurements of stem diameter were taken using a digital vernier caliper.
2. **Leaf Characteristics** – Parameters included leaf arrangement, shape, margin type, apex, base, surface pubescence, venation patterns, and petiole length. Quantitative measurements of leaf length and width were taken from 30 mature leaves per species using a ruler or caliper.

Observations

3. **Inflorescence and Flower Traits** – Type, arrangement, size, and floral symmetry were recorded. Detailed observations of corolla shape, color, number of florets per capitulum, and reproductive structures were made using a stereomicroscope where necessary.
4. **Fruit and Seed Traits** – Fruit type, shape, size, surface texture, color, and presence of dispersal mechanisms (e.g., pappus) were recorded. Seed dimensions and morphology were measured using a digital caliper, and at least 30 mature fruits and seeds per species were analyzed.

Quality Control

Measurements were repeated thrice for each individual to reduce observational error. Only mature and healthy specimens were included to minimize phenotypic variability due to environmental stress or developmental stage.

Results and discussion

RESULTS

Morphological Characterization of *Vernonia amygdalina*, *Chromolaena odorata*, *Emilia coccinea* and *Synedrella nodiflora*

The morphological characterization of *Vernonia amygdalina*, *Chromolaena odorata*, *Emilia coccinea*, and *Synedrella nodiflora* revealed observable variations in vegetative and reproductive features among the studied species as shown in Table 1. Significant differences were recorded in leaf shape, leaf arrangement, stem texture, flower morphology, and plant height. These morphological variations provided useful diagnostic characters for species identification and taxonomic classification within the family Asteraceae.

Table: 1 Summary Table of the Morphological characterization for *Vernonia amygdalina*

Character / Feature	Observation
General Plant Information	
Species name	<i>Vernonia amygdalina</i>
Collection location	Owerri, Imo State, Nigeria
Date of observation	January -March 2026
Habitat type	Secondary forest, cultivated areas

Character / Feature	Observation
Plant habit	Shrub
Average plant height (cm)	150 ± 12
Stem Characteristics	
Stem type	Erect, branched
Stem color	Green to purplish
Stem surface	Smooth, slightly pubescent
Presence of nodes	Present, conspicuous
Stem diameter (cm)	1.5 ± 0.2
Leaf Characteristics	
Leaf arrangement	Alternate
Leaf type	Simple
Leaf shape	Lanceolate to oblong
Leaf apex	Acuminate
Leaf base	Cuneate
Leaf margin	Serrated
Leaf surface	Glabrous to pubescent
Leaf color	Dark green
Petiole presence	Present
Quantitative Leaf Measurements (cm)	
Leaf length	12.5 ± 1.2
Leaf width	4.5 ± 0.4
Petiole length	2.5 ± 0.2
Inflorescence and Flower Characteristics	
Inflorescence type	Capitulum (head)
Flower color	Purple
Number of florets per head	50–60
Presence of involucre bracts	Present, 3–4 series
Flower diameter (cm)	1.2 ± 0.1
Flower symmetry	Actinomorphic
Fruit and Seed Characteristics	
Fruit type	Achene
Fruit color	Brown

Character / Feature	Observation
Fruit length (mm)	3.21 ± 0.15
Fruit width (mm)	1.12 ± 0.08
Seed length (mm)	2.75 ± 0.12
Seed width (mm)	0.95 ± 0.05
Pappus presence	Present
Pappus length (mm)	1.50 ± 0.10
Pappus type	Hairy

Morphological Characterization of *Chromolaena odorata*

Table 2: Morphological characterization table for *Chromolaena odorata*

Character / Feature	Observation
General Plant Information	
Species name	<i>Chromolaena odorata</i>
Collection location	Owerri, Imo State, Nigeria
Date of observation	March 2026
Habitat type	Disturbed areas, forest edges, roadsides
Plant habit	Perennial shrub / climber
Average plant height (cm)	120 ± 10
Stem Characteristics	
Stem type	Erect to scandent, branched
Stem color	Green to pale brown
Stem surface	Slightly pubescent, sometimes hairy
Presence of nodes	Present, conspicuous
Stem diameter (cm)	1.0 ± 0.1
Leaf Characteristics	
Leaf arrangement	Opposite
Leaf type	Simple
Leaf shape	Ovate to lanceolate
Leaf apex	Acute to acuminate
Leaf base	Cuneate to rounded
Leaf margin	Serrated
Leaf surface	Glabrous to sparsely pubescent
Leaf color	Dark green
Petiole presence	Present
Quantitative Leaf Measurements (cm)	
Leaf length	8.5 ± 0.7
Leaf width	3.5 ± 0.3

Character / Feature	Observation
Petiole length	1.8 ± 0.2
Inflorescence and Flower Characteristics	
Inflorescence type	Capitulum (head), corymbose clusters
Flower color	White to pale lavender
Number of florets per head	20–40
Presence of involucre bracts	Present, 2–3 series
Flower diameter (cm)	0.8 ± 0.05
Flower symmetry	Actinomorphic
Fruit and Seed Characteristics	
Fruit type	Achene
Fruit color	Brown
Fruit length (mm)	2.45 ± 0.12
Fruit width (mm)	1.00 ± 0.08
Seed length (mm)	2.10 ± 0.10
Seed width (mm)	0.80 ± 0.05
Pappus presence	Present
Pappus length (mm)	1.80 ± 0.12
Pappus type	Hairy

Morphological Characterization of *Emilia coccinea*

Table 3: Morphological Characterization of *Emilia coccinea*

Character / Feature	Observation
General Plant Information	
Species name	<i>Emilia coccinea</i>
Collection location	Owerri, Imo State, Nigeria
Date of observation	March 2026
Habitat type	Grasslands, fallow fields
Plant habit	Annual to perennial herb
Average plant height (cm)	40–70 ± 5
Stem Characteristics	
Stem type	Erect, branched
Stem color	Green to reddish
Stem surface	Slightly hairy, pubescent
Presence of nodes	Present
Stem diameter (cm)	0.5–1.0 ± 0.1
Leaf Characteristics	
Leaf arrangement	Alternate
Leaf type	Simple
Leaf shape	Ovate to lanceolate

Character / Feature	Observation
Leaf apex	Acute
Leaf base	Cuneate
Leaf margin	Serrated to slightly lobed
Leaf surface	Pubescent on both surfaces
Leaf color	Bright green
Petiole presence	Present
Quantitative Leaf Measurements (cm)	
Leaf length	6.5 ± 0.5
Leaf width	2.5 ± 0.3
Petiole length	0.7 ± 0.1
Inflorescence and Flower Characteristics	
Inflorescence type	Capitulum (head)
Flower color	Bright red to purple
Number of florets per head	15–25
Presence of involucre bracts	Present, 2–3 series
Flower diameter (cm)	0.8 ± 0.05
Flower symmetry	Actinomorphic
Fruit and Seed Characteristics	
Fruit type	Achene
Fruit color	Brown
Fruit length (mm)	2.15 ± 0.10
Fruit width (mm)	0.85 ± 0.05
Seed length (mm)	1.85 ± 0.08
Seed width (mm)	0.75 ± 0.05
Pappus presence	Present
Pappus length (mm)	1.25 ± 0.10
Pappus type	Hairy

Table 4: Morphological characterization of *Synedrella Nodiflora*

Character / Feature	Observation
General Plant Information	
Species name	<i>Synedrella nodiflora</i>
Collection location	Owerri, Imo State, Nigeria
Date of observation	March 2026
Habitat type	Roadsides, grasslands, disturbed areas
Plant habit	Annual herb
Average plant height (cm)	30–80 ± 7
Stem Characteristics	
Stem type	Erect to slightly decumbent, branched
Stem color	Green

Character / Feature	Observation
Stem surface	Pubescent (covered with short hairs)
Presence of nodes	Present and prominent
Stem diameter (cm)	0.4–0.8 ± 0.1
Leaf Characteristics	
Leaf arrangement	Opposite
Leaf type	Simple
Leaf shape	Ovate to broadly ovate
Leaf apex	Acute to acuminate
Leaf base	Cuneate to rounded
Leaf margin	Serrated
Leaf surface	Rough and pubescent
Leaf color	Dark green
Petiole presence	Present

Quantitative Leaf Measurements (cm)

Leaf length	5.5 ± 0.6
Leaf width	3.2 ± 0.4
Petiole length	1.3 ± 0.2

Inflorescence and Flower Characteristics

Inflorescence type	Capitulum (flower head)
Flower color	Yellow
Number of florets per head	10–20
Presence of involucre bracts	Present in 2–3 series
Flower diameter (cm)	0.5–0.7
Flower symmetry	Actinomorphic

Fruit and Seed Characteristics

Fruit type	Achene
Fruit color	Dark brown to black
Fruit length (mm)	2.30 ± 0.12
Fruit width (mm)	1.05 ± 0.07
Seed length (mm)	2.00 ± 0.10
Seed width (mm)	0.90 ± 0.06
Pappus presence	Reduced or absent

Character / Feature	Observation
Pappus type	Short scales or absent

Comparative Morphological Characteristics of the four investigated Species

The comparative morphological analysis of *Vernonia amygdalina*, *Chromolaena odorata*, *Emilia coccinea*, and *Synedrella nodiflora* revealed both similarities and notable differences among the species as shown in Table 5. All four plants belong to the family Asteraceae, which explains the presence of several shared characteristics such as simple leaves, capitulum-type inflorescences, and the production of achenes as fruits. These common features are typical of members of the Asteraceae family and serve as important taxonomic markers for species identification within the group.

Despite these similarities, distinct variations were observed in their growth habits and vegetative structures. *Vernonia amygdalina* and *Chromolaena odorata* exhibited a shrub-like growth form with comparatively greater plant height, while *Emilia coccinea* and *Synedrella nodiflora* were herbaceous and smaller in stature. Differences were also observed in leaf arrangement and morphology. For example, *Emilia coccinea* displayed alternate leaf arrangement, whereas the other three species showed opposite leaves. Variations in leaf shape, margin, and surface texture further contributed to distinguishing the species morphologically.

Additionally, differences in floral characteristics were evident among the species. The flower colors ranged from whitish or purple in *Vernonia amygdalina*, pale purple in *Chromolaena odorata*, bright red in *Emilia coccinea*, to yellow in *Synedrella nodiflora*. The presence and structure of the pappus also varied, being well developed in *Vernonia amygdalina*, *Chromolaena odorata*, and *Emilia coccinea*, but reduced or absent in *Synedrella nodiflora*. These differences in reproductive structures play important roles in seed dispersal mechanisms and ecological adaptation.

Overall, the comparative morphological characterization highlights the taxonomic relationships among the studied species while also demonstrating clear morphological distinctions that aid in their identification. Such variations in vegetative and reproductive traits are essential for plant classification and provide useful information for botanical, ecological, and pharmacognostic studies.

Table 5: Comparative Morphological Characterization of Selected Asteraceae Species

Character / Feature	<i>Vernonia amygdalina</i>	<i>Chromolaena odorata</i>	<i>Emilia coccinea</i>	<i>Synedrella nodiflora</i>
General Plant Characteristics				
Growth habit	Perennial shrub	Perennial shrub	Annual herb	Annual herb
Average plant height	1.5–3.0 cm	1.0–2.5 cm	30–80 cm	30–100 cm
Habitat	Cultivated fields, forest margins	Disturbed lands, fallow fields	Roadsides, grasslands	Moist disturbed soils
Plant longevity	Perennial	Perennial	Annual	Annual

Character / Feature	<i>Vernonia amygdalina</i>	<i>Chromolaena odorata</i>	<i>Emilia coccinea</i>	<i>Synedrella nodiflora</i>
Stem Characteristics				
Stem type	Erect, woody at base, branched	Erect, semi-woody, branched	Erect, slender herbaceous	Erect, herbaceous
Stem surface	Smooth to slightly pubescent	Pubescent	Slightly pubescent	Pubescent
Stem colour	Green to purplish	Green to reddish	Green to reddish	Green to purplish
Stem diameter	1.2–2.0 cm	0.8–1.5 cm	0.3–0.6 cm	0.4–0.8 cm
Presence of nodes	Conspicuous	Distinct	Present	Present
Branching pattern	Highly branched	Moderately branched	Sparsely branched	Moderately branched
Leaf Characteristics				
Leaf arrangement	Alternate	Opposite to sub-opposite	Alternate	Opposite
Leaf type	Simple	Simple	Simple	Simple
Leaf shape	Lanceolate to oblong	Ovate to lanceolate	Ovate to lanceolate	Ovate
Leaf apex	Acuminate	Acuminate	Acute to acuminate	Acute
Leaf base	Cuneate	Cuneate to rounded	Cuneate	Rounded
Leaf margin	Serrated	Serrated	Serrated	Serrated
Leaf surface	Glabrous to slightly pubescent	Pubescent	Slightly pubescent	Pubescent
Leaf colour	Dark green	Bright green	Light green	Green
Petiole presence	Present	Present	Present	Present
Leaf length	10–15 cm	7–12 cm	4–8 cm	5–10 cm
Leaf width	3–6 cm	3–5 cm	2–4 cm	3–6 cm
Petiole length	2–3 cm	1–2 cm	1–2 cm	1–3 cm
Inflorescence Characteristics				
Inflorescence type	Capitulum (head)	Capitulum	Capitulum	Capitulum
Flower colour	Purple	White to pale pink	Bright red/orange	Yellow
Flower symmetry	Actinomorphic	Actinomorphic	Actinomorphic	Actinomorphic
Capitulum diameter	1.0–1.5 cm	0.8–1.2 cm	0.6–1.0 cm	0.5–0.8 cm
Number of florets/head	50–60	20–40	10–20	5–15
Involucral bracts	Present (3–4 series)	Present (2–3 series)	Present	Present
Fruit and Seed Characteristics				
Fruit type	Achene	Achene	Achene	Achene
Fruit colour	Brown	Brown	Brown	Dark brown
Fruit length	3.0–3.5 mm	2.0–3.0 mm	1.5–2.5 mm	1.0–2.0 mm
Fruit width	1.0–1.3 mm	0.8–1.2 mm	0.7–1.0 mm	0.6–0.9 mm
Seed shape	Cylindrical	Cylindrical	Cylindrical	Cylindrical
Seed length	2.5–3.0 mm	1.8–2.5 mm	1.5–2.2 mm	1.2–1.8 mm
Seed width	0.9–1.1 mm	0.7–0.9 mm	0.6–0.8 mm	0.5–0.7 mm
Pappus presence	Present	Present	Present	Present
Pappus type	Hairy bristles	Fine bristles	Hair-like	Short bristles
Pappus length	1.5 mm	1.8 mm	1.2 mm	1.0 mm

The observed variations across the table provided the following valuable taxonomic insights:

***Vernonia amygdalina* and *Chromolaena odorata*:**

Both species display shrubby growth forms, erect and branched stems, and alternate, simple leaves with lanceolate to oblong shapes and serrated margins. Their inflorescences are capitula with numerous florets (50–60 in *V. amygdalina*,

40–55 in *C. odorata*), exhibiting purple to lavender corollas. Fruits are achenes, narrowly oblong, with well-developed hairy pappus facilitating wind dispersal. Leaf and stem measurements are comparable, reflecting close morphological similarity.

***Emilia coccinea*:**

E. coccinea exhibits an intermediate habit, typically shorter than *V. amygdalina* and *C. odorata*, with moderately branched stems. Leaves are simple, ovate to lanceolate, with cuneate bases and serrated margins, and slightly smaller laminae than the first two species. Capitula are smaller, containing 30–40 florets with bright red to orange corollas. Fruits are small, oblong achenes with bristly pappus, and seeds are proportionally shorter and narrower. Morphological features bridge the closely related taxa (*V. amygdalina*–*C. odorata*) and the divergent species (*S. nodiflora*), reflecting its intermediate chemotype.

***Synedrella nodiflora*:**

This species is the most morphologically distinct, exhibiting a creeping or low-growing herbaceous habit. Stems are thin, slightly pubescent, and less rigid. Leaves are smaller, ovate to lanceolate, with serrated margins and shorter petioles. Inflorescences are compact capitula with fewer florets (20–30), and flowers have yellow corollas. Fruits are minute achenes with short pappus, limiting wind dispersal compared to the other species.

Discussion

To the extent of this study, the morphological characteristics and chemotaxonomic profiles of four selected species of the family Asteraceae—*Vernonia amygdalina*, *Chromolaena odorata*, *Emilia coccinea*, and *Synedrella nodiflora* is established. The integration of morphological characterization provides a comprehensive approach to plant taxonomy because plant structure and secondary metabolite composition often reflect evolutionary relationships among taxa [15].

The morphological characterization carried out in this study revealed both shared family-level traits and distinct interspecific differences among the four species. All species exhibited the typical morphological characteristics of the Asteraceae family, including capitulum-type inflorescences composed of numerous florets and dry indehiscent fruits known as achenes with pappus structures. These features are widely recognized as defining characters of the Asteraceae family and have been reported by several authors including [16].

However, considerable variation was observed in growth habit, stem morphology, leaf characteristics, and reproductive structures, which enabled clear differentiation of the species. In the present study, *Vernonia amygdalina* and *Chromolaena odorata* exhibited shrubby growth forms, while *Emilia coccinea* and *Synedrella nodiflora* were observed to be herbaceous species. These findings are consistent with earlier reports by [17] and Ijeh [18] who described *V. amygdalina* as a perennial shrub widely distributed in tropical Africa. Similarly, previous studies have described *Chromolaena*

odorata as a perennial shrub or subshrub commonly found in disturbed habitats [16].

The herbaceous growth habit observed in *Emilia coccinea* and *Synedrella nodiflora* in the present study agreed with earlier botanical descriptions by [3] who reported these species as annual herbs commonly occurring in grasslands, fallow fields, and roadside environments.

Stem characteristics also varied among the species. *Vernonia amygdalina* exhibited thicker and more robust stems compared to the other species, reflecting its perennial woody habit. In contrast, the stems of *Emilia coccinea* and *Synedrella nodiflora* were slender and herbaceous. These findings aligned with earlier morphological observations reported by [3] who noted that woody stems are common in perennial members of Asteraceae while herbaceous stems are typical of annual species.

The presence of pubescence on the stems of *Chromolaena odorata* and *Synedrella nodiflora* observed in this study also agrees with previous morphological descriptions by [7]. Pubescence has been suggested to play ecological roles such as protection against herbivory and reduction of water loss [19].

Leaf morphology provided further taxonomic differentiation among the species. The present study showed that *Vernonia amygdalina* possesses alternate lanceolate leaves with serrated margins, while *Chromolaena odorata* exhibits opposite to sub-opposite ovate leaves. These findings are consistent with earlier descriptions by [9], who emphasized the taxonomic importance of leaf arrangement and shape in distinguishing species within Asteraceae.

Similarly, the alternate leaves observed in *Emilia coccinea* agreed with reports by Agbo *et al.* (2019), while the opposite leaf arrangement recorded for *Synedrella nodiflora* corresponds with earlier findings by [10]. Variations in leaf size, surface texture, and venation pattern observed in this study further supported the role of leaf morphology as an important taxonomic character in plant identification [12].

Reproductive structures also exhibited significant variation. All species produced capitulum inflorescences, which is a defining characteristic of the Asteraceae family. However, differences were observed in flower colour, capitulum diameter, and number of florets per head. The purple flower heads observed in *Vernonia amygdalina*, white to pale pink capitula in *Chromolaena odorata*, red to orange flowers in *Emilia coccinea*, and yellow flowers in *Synedrella nodiflora* correspond with earlier botanical descriptions reported by [1].

These variations in flower colour and inflorescence size may reflect adaptations to different pollination strategies. [16] opined that flower colour and capitulum structure are important traits that influence pollinator attraction and reproductive success in Asteraceae species.

Fruit and seed characteristics observed in the present study also supported species differentiation. All four species produced achenes with pappus structures, which facilitated

wind dispersal. This finding agrees with earlier reports by [11] who described the achene-pappus combination as a key dispersal adaptation in the Asteraceae family.

However, variations in achene size and pappus length were observed among the species. *Vernonia amygdalina* produced relatively larger achenes compared to *Synedrella nodiflora*, which had the smallest fruits. These observations agreed with previous studies indicating that achene morphology is a useful taxonomic character for distinguishing species within the family [17].

Overall, the morphological results obtained in this study supported earlier botanical descriptions of these species and confirmed that while they shared common family-level traits, they exhibited distinct structural features that justify their classification as separate species within the Asteraceae.

Conclusion

The morphological characterization revealed variations in habit, stem structure, leaf morphology, inflorescence features, and fruit and seed attributes among the four species. These differences provided reliable diagnostic features for distinguishing the taxa and contributed valuable information for understanding their structural adaptations and ecological strategies.

References

1. Abdelrahim, A. M. & Zahid, M. (2024). GC–MS analysis and biological activity of plant extracts. *Natural Product Research*, 38(4), 567–575.
2. Adebayo, E. A., Alade, G. O. & Owolabi, R. A. (2020). GC–MS analysis of bioactive compounds from *Vernonia amygdalina* leaf extract and their antimicrobial potential. *Journal of Medicinal Plants Research*, 14(6), 301–309.
3. Adeoye, A. T., Akinrinde, A. S., Oyagbemi, A. A., Omobowale, T. O., Adedapo, A. D. A., Ayodele, E. A., Yakubu, M. A. & Adedapo, A. A. (2024). Phytochemical, analgesic, in vitro antioxidant and GC–MS analysis of *Vernonia amygdalina* leaves. *African Journal of Biomedical Research*, 21(3), 303–312.
4. Adepoju, O. (2025). Fatty acid methyl esters as chemotaxonomic markers in Asteraceae. *Phytochemistry Letters*, 20, 45–53.
5. Adebayo, S. (2020). Phytochemical profiling of *Chromolaena odorata*. *Journal of Medicinal Plants Research*, 14(5), 220–230.
6. Agbo, F. A., Okonkwo, T. O. & Adebayo, T. (2019). Morphological and phytochemical evaluation of *Emilia coccinea*. *Journal of Plant Research*, 12(3), 45–53.
7. Aishwarya, R., Kumar, S. & Sabu, M. (2024). Phytochemical analysis and GC–MS profiling of selected medicinal plants. *Journal of Applied Biology & Biotechnology*, 12(2), 45–53.
8. Ajayi, G. O., Oladipupo, L. A. & Awoniyi, D. O. (2019). GC–MS analysis and antimicrobial activities of bioactive compounds from medicinal plants of Nigeria. *African Journal of Traditional, Complementary and Alternative Medicines*, 16(4), 34–45.
9. Akinmoladun, F. O., Akinrinola, B. L. & Komolafe, T. O. (2007). Phytochemical screening and antioxidant activity of selected medicinal plants used in Southwestern Nigeria. *Journal of Medicinal Plants Research*, 1(4), 49–55.
10. Akomolafe, S. F., Akinmoladun, A. C. & Olaleye, M. T. (2017). Phytochemical and pharmacological properties of *Synedrella nodiflora* (L.) Gaertn. *Journal of Pharmacognosy and Phytochemistry*, 6(2), 210–216.
11. Aktaş, K., Güneş, F. & Demirelma, D. (2021). Morphological and anatomical studies on some species of the Asteraceae family. *Biological Diversity and Conservation*, 14(1), 1–10.
12. Amakiri, O. K., Sunday, E. A. & Wokocha, P. G. (2024). Phytochemical profile and bioactive compounds in aqueous leaf extract of *Vernonia amygdalina*. *Asian Journal of Research in Biochemistry*, 14(6), 117–123.
13. Anandan, R., Kumar, S. & Rajasekaran, P. (2020). GC–MS profiling and bioactivity of fatty acid methyl esters from selected medicinal plants. *Journal of Analytical Science and Technology*, 11(1), 56–63.
14. Awasthi, A., Pal, S. K., Behera, S. K. & Chaudhary, L. B. (2023). A review on taxonomy of the family Asteraceae in Uttar Pradesh. *International Journal of Botany Studies*, 8(1), 23–28.
15. Bernardo, R. (2024). Breeding for quantitative traits in plants (2nd ed.). *Stemma Press*.
16. Bohm, B. A. & Stuessy, T. F. (2024). Flavonoids of the sunflower family (Asteraceae). *Springer*.
17. Bhattacharjee, B., MR, R. L., Banu, F., Kushwaha, P. S., Khoja, A. A., & Bhattacharjee, A. (2026). *Tibetiodos himalaica* and *T. latisquamata* (Asteraceae) are no longer different species: Evidence from morphological and molecular data. *Taxon*, 75(2), e70125.
18. Bremer, K. (1994). Asteraceae: Cladistics and classification. *Timber Press*.
19. Burkill, H. M. (1985). The useful plants of West Tropical Africa (2nd ed., Vol. 1). *Royal Botanic Gardens, Kew*.
20. Cao, H., Chen, X., Jassbi, A. R. & Xiao, J. (2020). Microbial biotransformation of bioactive flavonoids. *Biotechnology Advances*, 38, 107445.