



Taxonomic Significance of Morphological Characters in the Species of *Stachytarpheta* Found in Awka, Nigeria

**Chisom F. Iroka^{1*}, Clement U. Okeke¹, Alex I. Izundu¹, Nkumah C. Okereke²,
Bio Louis Nyanayo³ and Kenneth U Ekwealor¹**

¹Department of Botany, Nnamdi Azikiwe University, P. M. B 5025 Awka, Anambra State, Nigeria.

²Department of Applied Biology, Ebonyi State University Abakaliki, Ebonyi State, Nigeria.

³Department of Plant Science and Biotechnology, University of Port Harcourt, Rivers State, Nigeria.

Authors' contributions

This work was carried out in collaboration between all authors. Authors CUO and CFI designed the study, wrote the protocol, managed the analyses of the study and wrote the first draft of the manuscript. Author CFI carried out the laboratory work under supervision of authors All and BLN. Authors NCO, KUE and CFI performed the statistical analysis, wrote the final draft and managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2015/19409

Editor(s):

(1) Dionisios Gasparatos, Soil Science Laboratory, Faculty of Agriculture, Aristotle University of Thessaloniki, Greece.

Reviewers:

(1) Mohannad AL-Saghir, Ohio University, USA.

(2) K. Omkar, Rayalaseema University, India.

(3) Saraswati Nandan Ojha, National Bureau of Plant Genetic Resources (ICAR), Uttarakhand, India.

Complete Peer review History: <http://sciencedomain.org/review-history/10694>

Original Research Article

Received 8th June 2015
Accepted 31st July 2015
Published 24th August 2015

ABSTRACT

A morphological study on the genus of *Stachytarpheta* found in Awka, South Eastern region of Nigeria was carried out. This was done by physical observation and measurement of physiognomic features of fresh floral and vegetative parts of the plants. From the result of the analyses carried out, *S. jamaicensis* had an erect growth habit and stem branching was dichotomous, *S. cayennensis* was erect and low in growth habit, slightly woody at the base with dichotomous stem branching while *S. angustifolia* was weakly erect and stem branched dichotomously. Stem and petiole colour of *S. jamaicensis* and *S. angustifolia* was rarely similar while *S. cayennensis* had a purplish stem and petiole. Stem of the three species of *Stachytarpheta* were quadrangular (square shaped) towards the shoot but circular towards the base of the stem, Leaf was alternate or

*Corresponding author: E-mail: harlyz14@yahoo.com;

opposite and whorled in *S. jamaicensis* and *S. angustifolia* but opposite in *S. cayennensis*. Leaf colour was bluish or grayish in *S. jamaicensis*, greenish-gray in *S. angustifolia* and grayish-green flushed with purple in *S. cayennensis*. In addition, leaf shape, leaf base, leaf tip and leaf blade was also studied. Flowers were sessile in all three species of *Stachytarpheta*; they were semi immersed in the rachis depression in *S. cayennensis*. 3-5 flowers at a time in *S. jamaicensis* and *S. angustifolia*, 3-4 flowers in *S. cayennensis*. However, from the study carried out these morphological similarities are more between *S. jamaicensis* and *S. angustifolia* thereby delimiting *S. cayennensis* which had more isolated features.

Keywords: *Angustifolia*; *Cayennensis*; *Jamaicensis*; *morphological*; *physiognomic*; *Stachytarpheta*; *Verbenaceae*.

1. INTRODUCTION

Verbenaceae is predominantly a tropical family of about 98 genera and 3,000 species, exhibiting a wide range of growth habit and inhabiting diverse habitats [1,2]. They are known to be low shrubs, herbs or trees. Flowers are in spikes. The genus *Stachytarpheta* Vahl. is however, a member of the family Verbenaceae, having three prominent species in West Africa and Nigeria, namely: *Stachytarpheta cayennensis* (Rich.) Vahl commonly known as Brazilian weed or Bastard varvain; *S. angustifolia* (Mill.) Vahl commonly known as devil's coach weed and *S. jamaicensis* (L.) Vahl commonly known as potter weed [3]. These plants can serve as economic plants and may also be grown as ornamentals [4]. Members of family Verbenaceae are popular in traditional medicine where they are used for treatment of various ailments. Moreover, all the *Stachytarpheta* species have been used ethnomedically as anti-diabetic, sedative, antihypertensive, anti-asthmatic and anti-fever [5].

Stachytarpheta species is generally an erect and branched half-woody plant, with stem slightly angled. The leaves are elliptic to oblong-ovate and 2 to 10 cm long. The leaf tips are pointed with toothed margins. The leaf base is decurrent on the petiole. The spikes are terminal, rather slender, 10-30 cm long, 3-4 mm thick, green and continuous. The calyx is small, oblique and 4-toothed. The corolla is deep-blue or blue-purple, 1 cm long. The fruit is enclosed in the calyx and oppressed to and somewhat sunk in the rachis which is smooth, oblong and about 4 mm long [2].

Plant morphology is the study of the physical form and external structure of the plants [6]. This is usually considered distinct from plant anatomy, which is the study of the internal structures of plant [7], especially at the

microscopic level. Plant morphology is however, very useful in the identification of plants [8]. Plant morphology represents a study of the development, form and structure of plants and by implication an attempt to interpret these on the basis of similarity of plants and origin [9]. Basically, morphology is comparative, which means that the morphologist tries to examine structures in many different plants of the same or different species, reaching a conclusion in comparisons and thereby formulates ideas about similarities [10]. When characters are used in description or identification, those characters are said to be diagnostic or key characters which can be either qualitative and/or quantitative. Hence, quantitative characters are morphological feature that can be counted or measured. For example a plant species has flower petals 10 – 12 mm wide. And qualitative characters are morphological features such as leaf shapes, flower colour or presence of hairs [11]. Therefore, both kinds of characters can be very useful for the identification of plants.

Plants however, exhibit natural variation in their form and structure [11,12]. It is quite obvious that all organisms vary from individual to individual, but plants exhibit an additional type of variation. Within a single individual, parts are repeated which may be different in form and structure from other similar parts. Basically, this variation is mostly seen in the leaves of a plant, although other organs in the plant, such as stems and flowers may show similar variation. According to [11] there were three primary causes of this variation, they are: positional effects, environmental effects and Juvenility. Although plants produce numerous copies of the same organ during their lives, not all copies of a particular organ will be purely identical. Hence, there is variation through the parts of a mature plant resulting from the relative position where the organ is produced, for example; along a new branch there may be variation in the leaves

consistent pattern along the branch [13,7]. The form of leaves produced near the base of the branch will also be different from leaves produced at tip of the same plant and this difference maintains consistency from branch to branch on a given plant [12]. [6] is of the opinion that this difference persists after the leaves at both ends of the branch have reached a certain stage of maturity and is not the result of some leaves being younger than others. However, the way in which new structures mature as they are produced may be affected by the point in the plants life when they begin to develop as well as by the environment to which the structures are exposed [9]. Plant biologists use morphological characters of plants which can be compared, measured, counted and described to assess the differences or similarities in plant taxa and use these characters for plant identification, classification and description, thus, solving taxonomic problems [11,7].

Due to the complexity in the taxonomic status of *Stachytarpheta* species, the work is aimed at the following:

- To verify the various morphological features of these plants in order to eliminate possible confusions in identifying them.
- To delineate the species by ascertaining and comparing their various morphological characters in order to establish a relationship.

2. MATERIALS AND METHODS USED IN THE STUDY

2.1 Collection and Identification of Plants

Samples of *S. cayennensis* and *S. jamaicensis* were collected from Nnamdi Azikiwe University Premises. *S. angustifolia* was collected from Adabebe village in Amawbia Community; Awka South L. G. A. Samples of *S. cayennensis*, *S. angustifolia* and *S. jamaicensis* collected were properly identified and authenticated by Prof. J.C Okafor and vouchers deposited at the Herbarium, Department of Botany, Nnamdi Azikiwe University, Awka.

2.1.1 Morphological analysis

Morphological assessment was by physical observation and measurement of physiognomic features of their fresh flower, leaf and stem specimen. Materials used include; a magnifying lens, a meter rule, a pair of forceps, sewing thread, petri dishes, razor blade and a camera. Photographs of the salient morphological feature were taken.

3. RESULTS

The result of the morphological analysis on the three *Stachytarpheta* species is presented in Table 1 and the plant photographs are also presented in Fig. 1.

Table 1. Summary of important morphological features

Features	<i>S. jamaicensis</i>	<i>S. cayennensis</i>	<i>S. angustifolia</i>
Growth habit	Erect or straggling	Erect	Erect or straggling
Stem colour	Purplish	Green or purple	Mostly greenish/purplish
Stem shape	Four angled	Four angled	Four angled
Presence of hair on stem	Sparsely pubescent or glabrate	Puberulent	Pubescent to sub-glabrous
Leaf	Alternate or opposite and whorled	Opposite	Opposite and whorled
Leaf colour	Bluish or grayish	Greenish to bluish	Bluish to greyish
Leaf shape	Oblong to elliptic or ovate	Elliptic	Elliptic to oblong or ovate
Flower	Inflorescence	Inflorescence	Inflorescence
Petal colour	Purplish or pale blue	White or lilac with white center.	Dark purple-blue
Presence of hair on leaf	Glabrate on upper surface, glabrous to strigose on the lower.	Pubescent on both surfaces	Sub glabrous on both surface
Leaf margin	Serrate	Serrate	Serrate
Leaf apex	Rounded to broadly acute	Rounded or pointed	Accuminate
Stem branching	Thyrse	Panicle	Thyrse

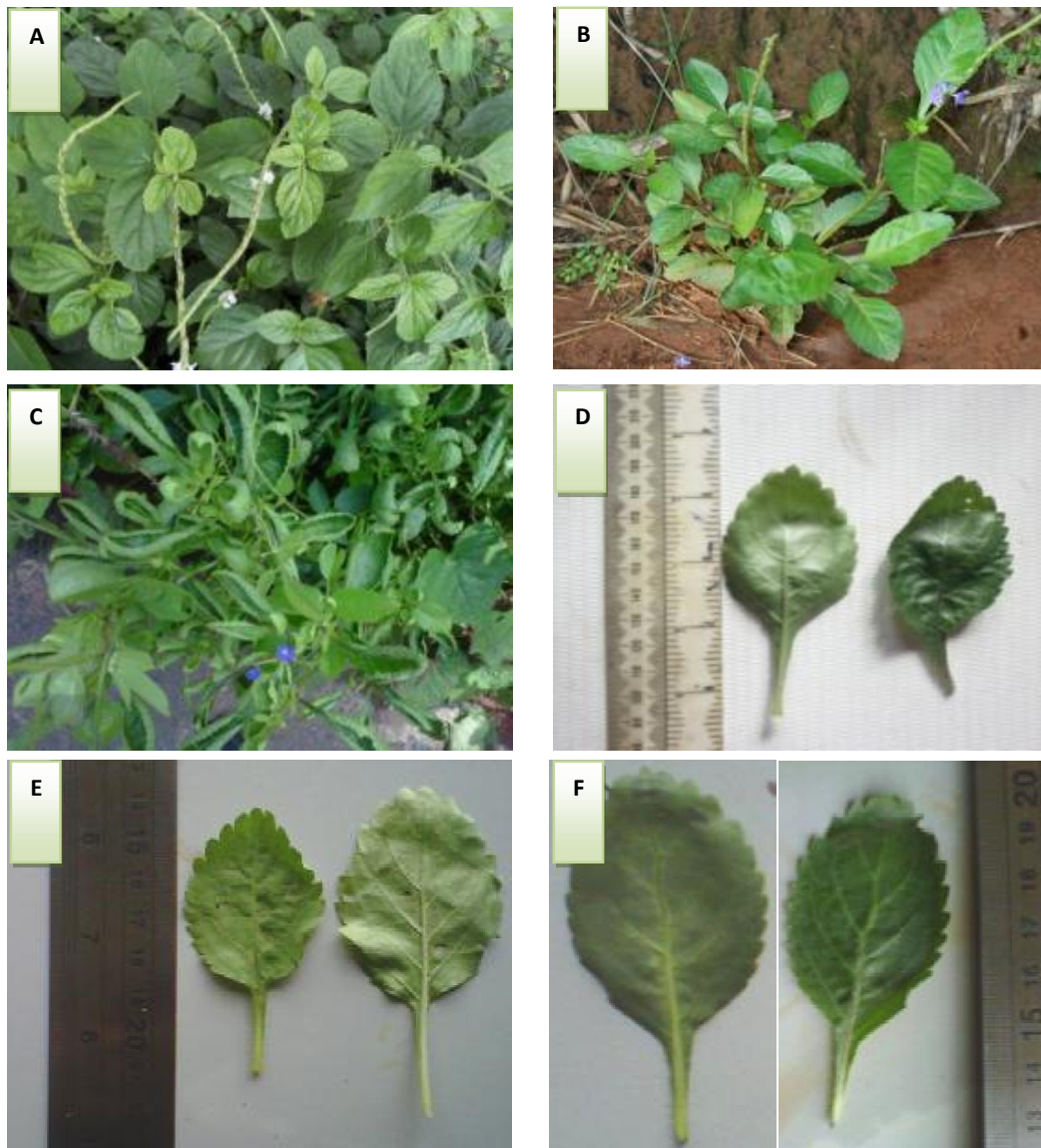


Fig. 1. Photographs of *Stachytarpheta* species

A. Habit photograph of *S. cayennensis*; B. Habit photograph of *S. jamaicensis*;
C. Habit photograph of *S. angustifolia*; D. Photo of adaxial and abaxial surface of *S. jamaicensis*;
E. Photo of adaxial and abaxial surface of *S. cayennensis*;
F. Photo of adaxial and abaxial surface of *S. angustifolia*

4. DISCUSSION

Morphological characters of plants can be compared, measured, counted and described to assess the differences or similarities in plant taxa and these characters are used for plant identification, classification and description, thus, solving taxonomic problems [11,7].

From the result of the analyses carried out, *S. jamaicensis* had an erect growth habit and

stem branching was dichotomous (thryse), *S. cayennensis* was erect and low in growth habit, slightly woody at the base with dichotomous stem branching (Panicle) while *S. angustifolia* was weakly erect and stem branched dichotomously (thryse); the plants habit and branching however, can be a diagnostic tool to distinguish *S. cayennensis* from the two other *Stachytarpheta* species based on the difference they pose.

Stem and petiole of *S. jamaicensis* was greenish in colour, with flushes of purple, *S. angustifolia* had greenish stem and petiole rarely purplish while *S. cayennensis* had a purplish stem and petiole. These characters are perhaps of little or no value in delimiting the species. Stem of the three species of *Stachytarpheta* were four angled (square shaped) towards the shoot but circular towards the base of the stem, which could be as a result of angular collenchymatous cells present around the upper part of the stem. Noticeable square-shaped stem is a diagnostic feature of the members of the family Verbenaceae [14]. Stem sometimes appeared roundish in shape, pubescent to subglabrous stem found in *S. angustifolia* and *S. jamaicensis* while *S. cayennensis* had a pubescent stem.

Leaf was alternate or opposite and whorled in *S. jamaicensis*, opposite in *S. cayennensis* but opposite and whorled in *S. angustifolia*. This character can however, be used to delimit *S. cayennensis* from the two other species. Leaf colour was bluish or grayish in *S. jamaicensis*, greenish-gray in *S. angustifolia* and grayish-green flushed with purple in *S. cayennensis*. These characters can also be useful as a taxonomic tool but must be carefully observed so as not to confuse it, this however, is in line with the reports of [15].

More so, the three species of *Stachytarpheta* were similar in being perennial herbs or shrubs, becoming dark brown or grayish brown when dry. Leaf blade was elliptic to oblong, 5-8 cm long and 2-5 cm wide in *S. cayennensis*. In *S. angustifolia*, leaf blade was ovate or broadly elliptic, 5-8 cm long and 3-6 cm wide. Leaf was dark green to glossy and bullate above, this was however, the same for *S. jamaicensis* but the later was darker, glossy and bullate above, but the midrib or the lateral vein was purplish above and purplish spots beneath. Hence, the leaf blade, shape and colour can be used as a diagnostic tool in delimiting the three species but difference more pronounced in *S. cayennensis*. Morphologically, leaf blades length was also variable among taxa, [16] reported that variations exist in the length and width of the leaf blades of *Cenchrus* species.

In addition, leaf was obtuse or abruptly acute apically in *S. angustifolia* and *S. jamaicensis*, it was coarse and serrated, with sharp teeth pointing outward, cuneately narrowed on the base and tapering to an indistinctly winged petiole of 0.5-2 cm length, it was also pilosulous on the

veins of the lower surface; whereas, leaf was obtuse or rounded apically in *S. cayennensis*, coarse and serrate with blunt teeth pointing forward, obliquely narrowed to the base and tapered to a winged petiole of 2-3 cm in length, also pilosulous on the veins of lower terminal. These however, can be used to delimit *S. cayennensis* from the other two species.

In *S. jamaicensis*, spikes were terminal, slender and flexible during anthesis, 25-40 cm long and 3 mm in diameter; dark green, sometimes flushed with purple and glabrous microscopically. Also, in *S. angustifolia* spikes were terminal, slender and flexible during anthesis, 24-40 cm in length and 3-4 mm in diameter; dark green sometimes flushed with purple and glabrous, but in *S. cayennensis*, spikes were terminal and stout, 25-50 cm long and 4-6 mm in diameter; grayish green flushed with purple, also glabrous. This however cannot be very helpful as a taxonomic tool to delineate these species as they all bore striking similarities.

Flowers were sessile in all three species of *Stachytarpheta*; they were semi immersed in the rachis depression in *S. cayennensis*. 3-5 flowers at a time in *S. jamaicensis* and *S. angustifolia*, 3-4 flowers in *S. cayennensis*. Bracts were ovate lanceolate, 5-6mm long and 2-5 mm wide in *S. cayennensis* but lanceolate, 4-5 mm long and 2 mm wide in the two other species.

5. CONCLUSION

Basically, these three species shared some common morphological features which may include; stem shape, inflorescence and leaf margin. Most of these morphological characters studied cannot be a significant taxonomic tool in identifying and delimiting these species of *Stachytarpheta* due to their similarities in characters. More so, from the study carried out these morphological similarities are more between *S. jamaicensis* and *S. angustifolia* thereby delimiting *S. cayennensis* which has more isolated features, therefore, from the affinity of characters observed between the three species in this study, as drawn from morphology it is obvious that *S. jamaicensis* and *S. cayennensis* were the putative parents, while *S. angustifolia* was the hybrid species.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Llyamma M, Shah GL. Anatomical contributions to the taxonomy of some Verbenaceae: Petiole. Roc. Indian Acad. Sc. (Plant Science). 1987;97:235-246.
2. Idu M, Erhabor JO, Odia EA. Morphological and anatomical studies of the leaf and stem of some medicinal plants *Stachytarpheta jamaicensis* (L) vahl and *S. cayennensis* (L.C. Rich). Schav-Ethnobotanical Leaflets. 2009;13: 1417-1425.
3. Hutchinson J, Dalziel JM. Flora of west tropical Africa (2nd Ed). London: Crown Agents; 1963.
4. Gill LS. Taxonomy of flowering plants. Bamenda: Cameron; 1988.
5. Schwontkowschi D. Herbs of the Amazon traditional and common uses. New York: Science Student Brain Trust Pub; 1993.
6. Raven PH, Johnson GB, Madison WI. Biology of Plants (2nd Ed). London: McGraw Hill; 1999.
7. Raven PH, Evert RH, Eichborn SE. Biology of Plants (7th Ed). New York: W.H Freeman; 2005.
8. Kirchoff BK, Pfeifer E, Rutishauser R. Plant structure ontology: How should we label plant structures with doubtful or mixed identities. Zootaxa. 2008;19(50):103-122.
9. Vergara-Silva F. Plants and the conceptual articulation of evolutionary developmental biology. Biology and Philosophy. 2003;18: 261-264.
10. Sattler R. Homology, homeosis and process morphology in plants. In: Hall BK, Ed. Homology: The hierarchical basis of Comparative Biology. New York: Academic Press; 1994.
11. Woodger JH. Biological principles. London: Routledge and Kegoan Paul; 1967.
12. Jeune B, Barabe D, Lacroix CR. Classical and dynamic morphology: Toward a synthesis through the space of forms. Acta Biotheoretica. 2006;54:277-293.
13. Leopold AC. Plant growth and development. New York: McGraw-Hill; 1964.
14. Esau K. Anatomy of seed plants. (3rd Ed). New York: John Wiley and sons Inc; 1977.
15. Adedeji O. Systematic significance of trichomes and foliar epidermal morphology in the species of *Stachytarpheta* vahl (Verbenaecae) Nigeria. Thiaszia Journal Botanica. 2012;22:1-31.
16. AHIRWAR M, BAIG MJ, PANDEY HC. Accumulation of photosynthetic pigments in *Cenchrus* species under different light intensities. Agricultural Science Research Journal. 2012;2:390-399.

© 2015 Iroka et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<http://sciencedomain.org/review-history/10694>