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A NEW INFRA-SPECIFIC TAXON OF *ACALYPHA FIMBRIATA* SCHUM. & THONN. FROM NIGERIA

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Keywords: Acalypha fimbriata; New variety; Nigeria.

Abstract

This study shows that the populations of *Acalypha fimbriata* Schum. & Thonn. occurring in Nigeria are divisible into two recognizable varieties, viz., *A. fimbriata* Schum. & Thonn. var. *fimbriata* and *A. fimbriata* var. *robusta* Kadiri var. nov. Generally, the populations have a suite of similar characters in their vegetative and reproductive organs and the ultra-structures of the leaf cuticle using scanning electron microscope showed uniformity of characters like sunken stomata, wide-narrow stomatal opening and conspicuous periclinal wall. However, the two varieties are discriminated based on 1 vs. 2 fruits per bract, slim vs. robust stature, scanty vs. clumsy inflorescence on the axillary spike, leaf apex character as well as smooth and rough unicellular trichomes. The observation is supported by a T-test at 95% similarity confidence while the 14 populations consisting of 280 individuals used for the analysis are separated into two by the scatter diagram. Neighbour joining analysis using Euclidean measure and UPGMA dendrogram reveal the level of relationships. Therefore, one of the varieties is based on the description of the earlier described type specimen and the other variety being different is considered as a new taxon *Acalypha fimbriata* var. *robusta* Kadiri.

Introduction

Acalypha L. (Euphorbiaceae) is pantropical in distribution, comprising about 450 species worldwide, 80 species in Africa and 15 species in West Africa with 9 species represented in Nigeria (Thonner, 1915; Hutchinson and Dalziel, 1958; Kadiri *et al*., 2009). They grow in a wide range of disturbed terrestrial habitats such as gutter-walls, farm lands, road sides, forest and savannah. Hutchinson and Dalziel (1958) and Burkill (1994) reported that they have high medicinal and aesthetic properties. *Acalypha fimbriata* Schum. & Thonn. is one of the well-spread species of the genus belonging to the series Polygynae-Pleurogynae Mull.-Arg. and section Ciliatae Mull-Arg. It is characterized by simple lanceolate leaves that is 4-10 x 2.5-4.0 cm in size. The inflorescence is arranged on axillary spike and the female flower is located within a boat-shaped bract having 3-chambered fruit that contains one seed per chamber. *Acalypha fimbriata* is medicinally important in respiratory and digestive problems, rheumatism and for sore and wound dressing (Burkill, 1994 and *personal communication* with natives). The bioactive principles are obtainable through the common practices of pulverisation, cooking, boiling and grinding.

De Candolle (1866) and Hepper (1976) considered the species as a synonym of *A. ciliata* Forsk. However, Radcliffe-Smith (1989, 1996) regarded them as distinct taxa because of differences in some morphological characters and added that *A. ciliata* is common in the north, while *A. fimbriata* is restricted to the south of Nigeria. Nevertheless, the two species can be contiguous in distribution but there is no doubt about the constancy of their distinctness (Radcliffe-Smith, 1989). *A. fimbriata* is well distributed in wet areas; it is usually found throughout rainy season and disappears as soon as dry season begins. During this period of growth, it was observed that individuals of the same population and locality have robust and slim

stature, clumsy and sparse inflorescence distribution, different number of ovary in a bract and some other morphological numerical differences. In view of this, the present study was carried out in order to scrutinize the heterogeneity of the populations across their entire range in the country, define the species properties as accurate and recognize the possible infra-specific taxa among the populations. The outcome of the study is expected to be valuable to individual plant recognition especially in medicine.

Materials and Methods

A total of 14 out of 18 populations were focused because of loss of assessable data in four of them, each containing 20 individuals were studied in the herbaria of Universities of Lagos (LUH) and Ibadan (UIH), Forestry Research Institute of Nigeria, Ibadan (FHI). The fresh samples collected from the fields were examined critically. Herbarium abbreviations are as reported by Holmgren *et al.* (1990) and provenances of the specimens used are shown in Table 1. Samples were collected at every 3rd, 4th or 5th step depending on size and degree of variability within the population, in line with the approach of Anderson (1941, 1943), Clausen (1960) and Olowokudejo (1995). They were examined both unaided and with the aid of x10 magnifying hand lens for exomorphological characteristics.

For scanning electron microscopy, approximately 8 mm^2 of the preserved leaves was hydrated in a solution of water Aerosol OT and chloral hydrate. They were later dehydrated in graded ethanol series: 50%, 70%, 90% and 100%; then bisected and mounted on stubs with adaxial and abaxial surfaces facing upward before sputter coating with Palladium Gold alloy. Samples were observed at 20KeV using Phillips 505T SEM and photographs were taken with Polaroid 55P/IN film. The approach followed Kadiri *et al.* (2009). Voucher specimens have been deposited in the herbarium and representative samples maintained in cultivation in the botanical garden of University of Lagos, Nigeria.

Principal component and neighbor joining analyses based on Euclidean similarity measure were performed with three characters (leaf apex length, number of inflorescence per plant and number of ovary in the bract), and a UPGMA dendogram based on the nine characters studied was generated using the statistical program of Hammer *et al.* (2001) to reflect the degree of relationships among the populations.

Results and Discussion

Acalypha fimbriata Schum. & Thonn. var. **fimbriata**

The taxon is representative of the type already described (Akobundu and Agyakwa, 1998). It was compared with the described *Acalypha ciliata* (Hutchinson and Dalziel, 1958), a very close ally, as there is no record of it in the flora (Hutchinson and Dalziel, 1958). Therefore, the attention given to it is for the purpose of comparison with the new taxon.

Acalypha fimbriata Schum. & Thonn. var. **robusta** Kadiri **var. nov.**

Diagnosis: *Folia apex acutatus-acuminatus, basis attenuatus-truncatus, margine serratus, forma ovatus-lanceolatus. Venatio craspedodroma, Folia magnitudo 4.8 – 6.3 × 3.0 – 3.6 cm, folia apex longitudo 9 -11 mm, petiolo longitudo 3.1 – 4.6 cm, inflorescentia numero 27 – 35, planta altitude 39.3 – 48.2 cm, pistillum numero per bractea 2, cuticularis, stomata depressus cum tenuis, stomata margine et latus - longust stomata apetura et conicus trichoma verruca.*

Type: Collected from c. 250 m from community primary school, Molade area, Iwo road Ibadan, 14 July 200. (*Holotype*: LUH; *Isotype*: FHI).

Table 1. Provenances of the specimens of *Acalypha fimbriata* used for the study.

No.	Localities	Voucher specimens
1	Ibadan	P. Wit, 17.8.1971, 27563 (FHI)
2	Ibadan	A. P. D. Jones, 23.10.1945, 13737 (FHI)
3	Igboora	O. B. B., 15.10.1981, 96310 (FHI)
4	Cross-River	Ibhanesbor and Oguntayo, 8.6.1972, 65249 (FHI)
5	Kwara	Olorunfemi and Ibhanesbor, 14.5.1973, 70013 (FHI)
6	Ibadan	M. C. Ejiofor, 7.9.1949, 24560 (FHI)
7	Abeokuta	Oduwo and Binuyo, 30.8.1984, 102011 (FHI)
8	Lagos	Oguntayo and Olorunfemi, 7.11.1977, 91921 (FHI)
9	Owena	Oyayomi and Osanyinlusi, 21.6.1977, 84421 (FHI)
10	Ago-Are	Olorunfemi *et al*., 19.10.1981, 96370 (FHI)
11	Ipake	Magbagboeola & Co., 1.2.1981, 94854 (FHI)
12	Otukpa	Emwiogbon and Oguntayo, 30.6.1978, 103402 (FHI)
13	Ohumbe	Oyayomi and Osanyinlusi, 13.6.1977, 82984 (FHI)
14	Cross-River	Ekwuno & Co, 14.3.1979, 89054 (FHI)
15	Cross-River	W. Punt, 22.5.1959, 51931 (FHI)
16	Abeokuta	C. Owechi, 22.5.1959, 52381 (FHI)
17	Lagos	J. G. Adam, 18.4.1959, 52381 (FHI)
18	Oshogbo	C. Owehi, 1.8.1964, 4485 (FHI)
19	Ibadan (Kadiri 2)	Kadiri, 10.9.1999, 2025 (LUH)
20	Ibadan	Kadiri, 8.7.2000, 2026 (LUH)
21	Ibadan	Kadiri, 26.10.2000, 2027 (LUH)
22	Ibadan	Kadiri, 6.7.2001, 2028 (LUH)
23	Iwo (Kadiri 55)	Kadiri, 9.8.2000, 2029 (LUH)
24	Ilorin (Kadiri 20)	Kadiri, 12.9.2000, 2030 (LUH)
25	Ijebu-Ode (Kadiri 4)	Kadiri, 26.10.2000, 2031 (LUH)
26	Ife (Kadiri 8)	Kadiri, 7.8.2000, 2032 (LUH)
27	Ibadan (Kadiri 15)	Kadiri, 9.8.2000, 2032 (LUH)
28	Ijebu- Ode (Kadiri 30)	Kadiri, 26.10.2000, 2033 (LUH)
29	Ijebu- Ode (Kadiri 35)	Kadiri, 3.12.2000, 2034 (LUH)
30	Iwo (Kadiri 29)	Kadiri, 6.7.2001, 2035 (LUH)
31	Ibadan (Kadiri 56)	Kadiri, 6.7.2001, 2036 (LUH)
32	Ibadan (Kadiri 57)	Kadiri, 14.7.2001, 2037 (LUH)
33	Igboora	Kadiri, 6.7.2001, 2036 (LUH)
34	Abeokuta	Kadiri, 14.7.2001, 2037 (LUH)
35	Ijebu-Ode	Kadiri, 22.10.2008, 2335 (LUH)
36	Ijebu-Igbo (Kadiri 28)	Kadiri, 18.11.2008, 2345 (LUH)
37	Shagamu	Kadiri, 12.12.2008, 2435 (LUH)
38	Ibadan (Kadiri 59)	Kadiri, 14.12.2008, 2467 (LUH)
39	Ibadan (Kadiri 12)	Kadiri, 12.2.2009, 2535 (LUH)

An annual herb, 30-70 mm long. Stem woody at the base and few to profusely branching. Leaves simple, alternate, 41-71 × 19-43 mm, usually lanceolate, margin serrate, base oblique, apex acuminate, petiole slender, 21-52 mm long. Inflorescence on axillary spikes, shorter than the petioles, inflorescence number 17-36 per individual. Flowers greenish, male flower is above the female, clumsy, arranged alternately in boat-shaped bracts. Fruit a 3-chambered capsule, usually 2 (very rarely 1) per bract, 1-2 mm long. Seeds brown, c. 1-3 mm long. Leaf cuticular characters include thin stomata rim, wide-long stomatal aperture and warty and long unicellular trichomes.

Phenology: Flowering: April to August; Fruiting: May to August.

Habitat: Farmland and roadside.

Distribution: It is very common in the south western to the south southern Nigeria.

Etymology: The name is based on the overall appearance of the plant.

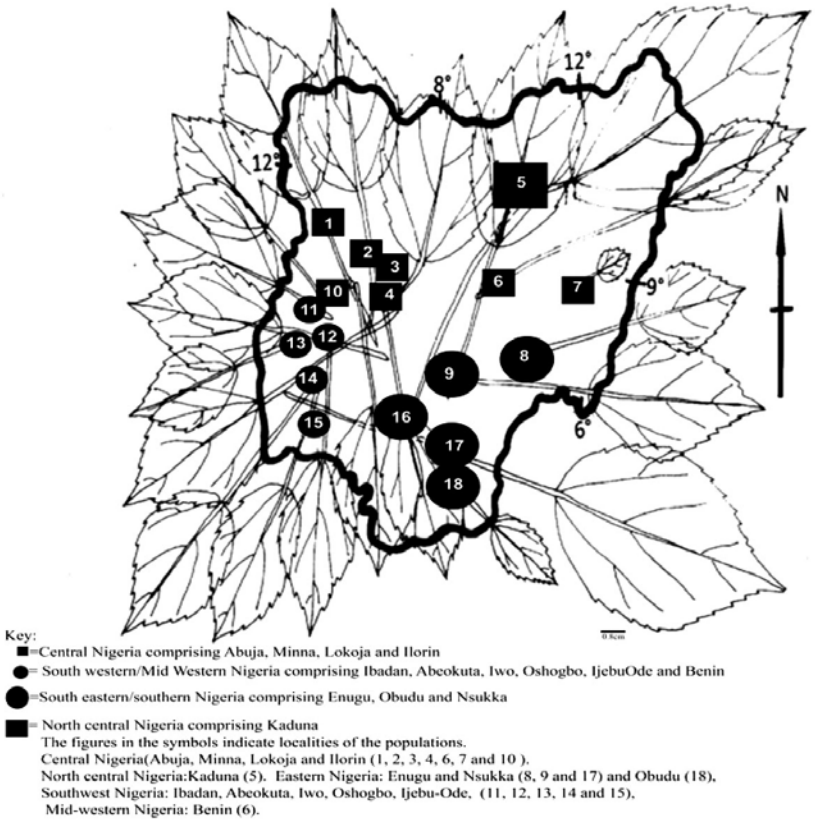


Fig. 1. Map of Nigeria showing distribution and leaf variations among the populations of *Acalypha fimbriata* across Nigeria.

The two varieties can be distinguished by number of ovaries per bract which is usually 1 in var. *fimbriata* and 2 in var. *robusta* (Fig. 2B, C, F, G) and mean inflorescence number on the axillary spike that is usually varied from 2-16 in the former and 27-35 in the latter (Table 2). Another important feature for distinction is the length of leaf apex; it varies from 5-8 mm in var. *fimbriata* to 9-11 mm in var. *robusta* (Fig. 2D, H; Table 2).

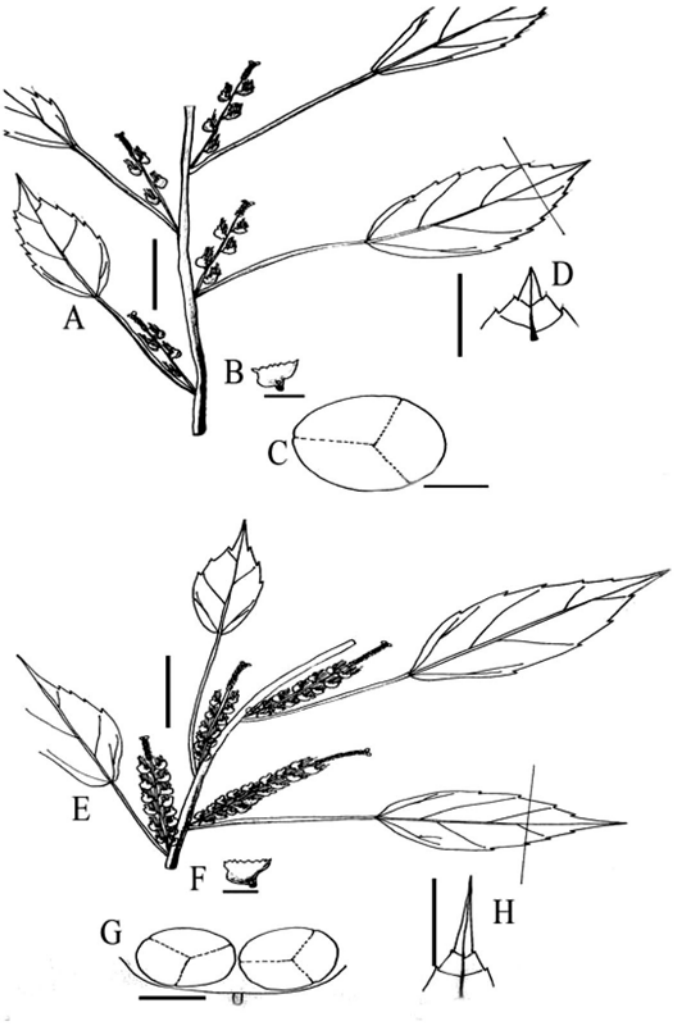


Fig. 2. Line drawings showing morphological features of the two infra-specific taxa of *Acalypha fimbriata*. A-D: *A. fimbriata* var. *fimbriata*, E-H: *A. fimbriata* var. *robusta* Kadiri **var. nov**. Kadiri. D and H: leaf apex; B and F, bracts partially sectioned to show fruits, C and G, number of fruits per bract. Scale bars: A, C, D, E, G and H = 1 cm; B and F = 0.6 cm.

Other features are stomatal complex configuration (thin-wide rim and narrow-wide plus long-short stomatal aperture) and the trichome ornamentation which is smooth in var. *fimbriata* and warty in var. *robusta* (Figs 3G; 4E, G). It was observed that individuals of the same populations often have different appearances. Some may have slim stature and scanty inflorescence distribution, while others have robust stature and clumsy inflorescence distribution (Fig 2). However, the leaf blade and petiole length reasonably overlap among the populations (Table 2). The present study also reveals that the populations of the species are clearly divided into the two recognized varieties using principal component analysis (Fig. 5A) and the relationship patterns are

Table 2. The quantitative characters of the populations of *Acalypha fimbriata* used for group recognition

Pop. Acc. No	Leaf width (mm)	Leaf length (mm)	Petiole length (mm)	Fruit length (mm)	Seed diameter (mm)	Plant height (cm)	Leaf apex (mm)	Pistil No.	Inflorescence no. per plant
Kadiri 2	23(37±2)39	52(65±2)70	40(49±2)52	1.0(1.5±0.1)2.0	1.0(2.0±0.2)2.0	35.0(43.4±5.0)47.6	5.0(6.0±2)7.0	1	6(8±2)9
Kadiri 8	26(39±3)43	50(58±3)68	32(37±3)41	1.0(0.9±0.2)1.5	1.0(2.0±0.2)2.0	28.3(34.5±3.5)39.8	7.0(8.0±2.0)8.5	1	14(16±5)18
Kadiri 30	24(30±1)32	53(58±3)62	28(33±2)40	1.6(2.3±0.2)2.5	1.0(2.0±0.2)2.0	19.4(22.3±2.8)26.4	5.5(6.0±2)7.0	1	6(8±2)10
Kadiri 4	25(38±2)42	54(63±2)67	38(42±2)47	1.0(2±0.3)2.2	1.0(3.0±0.2)3.0	24.4(30.0±3.1)42.0	7.0(8.0±2)9.0	1	2(2±0)2
Kadiri 12	22(32±2)35	48(55±3)58	10(16±3)23	0.8(1.0±0.1)1.0	1.0(2.0±0.2)2.0	18.9(27.7±2.9)31.4	4.7(5.0±2)6.0	1	6(8±2)9
Kadiri 55	18(31±2)34	48(58±2)63	32(44±3)53	1.0(2.0±0.1)2.0	1.0(3.0±0.2)3.0	29.3(40.3±5.1)49.4	6.5(7.0±2)8.0	1	12(13±3)15
Kadiri 56	20(36±2)39	60(63±4)69	22(30±2)34	1.0(2.0±0.1)2.0	1.0(2.0±0.2)2.0	19.2(27.9±3.2)38.3	7.0(8.0±2)9.0	1	11(12±2)15
Kadiri 28	21(25±3)30	46(53±2)61	26(32±3)41	1.0(2.0±0.1)2.0	1.0(3.0±0.2)3.0	24.4(39.3±3.3)46.2	9.5(10.0±3)11.0	2	34(35±5)37
Kadiri 29	25(31±4)36	43(55±3)64	21(31±2)43	1.0(2.0±0.1)2.0	1.0(3.0±0.2)3.0	35.1(48.2±5.3)70.0	8.0(9.0±3)10.0	2	26(29±4)32
Kadiri 35	30(38±3)43	48(54±2)65	34(46±2)54	1.0(2.0±0.1)2.0	1.0(2.0±0.2)2.0	33.1(44.4±5.7)52.0	8.5(9.0±3)10.5	2	17(19±3)21
Kadiri 20	28(32±2)36	52(61±5)71	23(32±3)42	1.0(2.0±0.1)2.0	1.0(3.0±0.2)3.0	30.2(39.3±3.3)43.6	9.0(10.0±3)11.0	2	28(30±6)34
Kadiri 57	21(31±2)34	43(55±2)65	30(43±2)52	1.0(2.0±0.1)2.0	1.0(2.0±0.2)2.0	31.1(40.4±5.1)52.3	8.5(9.0±2)10.0	2	27(32±4)36
Kadiri 15	23(30±3)34	41(50±3)60	22(31±3)40	1.0(2.0±0.1)2.0	1.0(3.0±0.2)3.0	34.2(48.0±5.2)55.8	8.0(9.0±2)10.0	2	24(27±3)31
Kadiri 59	19(31±3)35	58(48±2)62	25(33±2)42	1.0(2.0±0.1)2.0	1.0(3.0±0.2)3.0	31.2(46.0±5.2)54.4	10.0(11.0±3)12.0	2	26(30±4)33

reflected by the dendrograms of neighbour joining analysis and unweighted pair group method with arithmetic mean (UPGMA) (Figs 5B & 5C). The statistical interpretations (i.e. principal component analysis, neighbour joining and UPGMA dendrograms) of the findings reasonably support the division of the populations of the species into two and recognition of them as different varieties. One taking after the type specimen already described for *A. fimbriata* (Akobundu and Agyakwa, 1998) and deposited in the herbarium and the other being newly described for the first time in the present work as *A. fimbriata* var. *robusta*.

The distinctive morphological characterstics of *Acalypha fimbrita* var. *fimbriata* and *A. fimbriata* var. *robusta* are presented in Table 3.

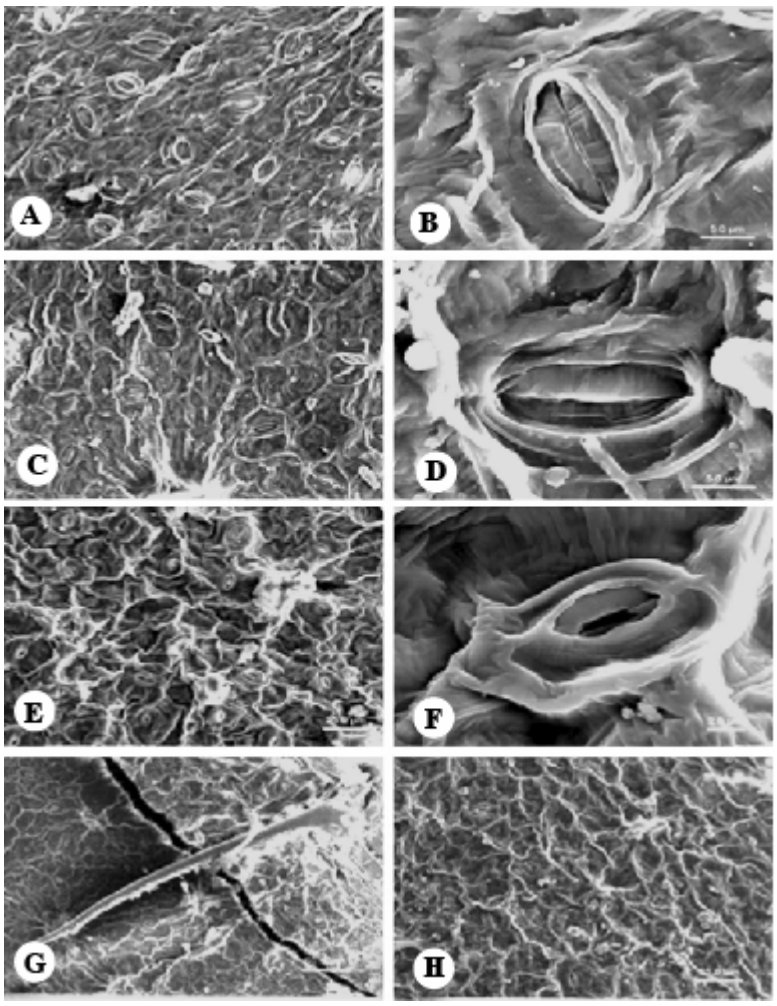


Fig. 3. Scanning electron micrographs of leaf surfaces of *Acalypha fimbriata* var. *fimbriata* A – F: Abaxial surface; G – H: Adaxial surface (presence of long unicellular trichome in G).

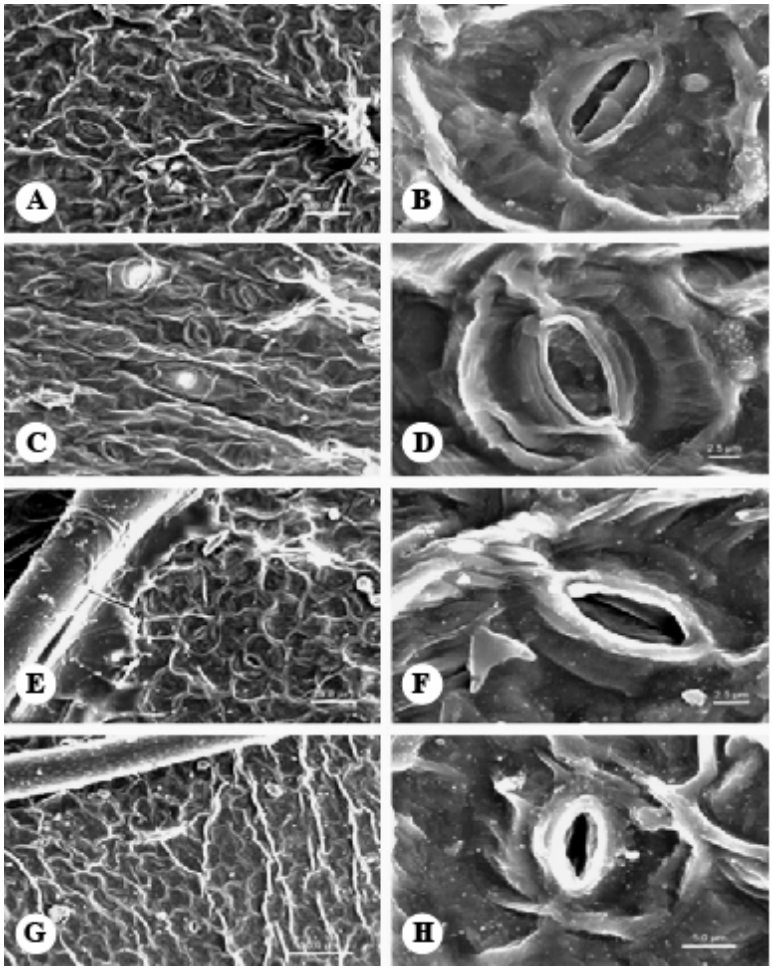
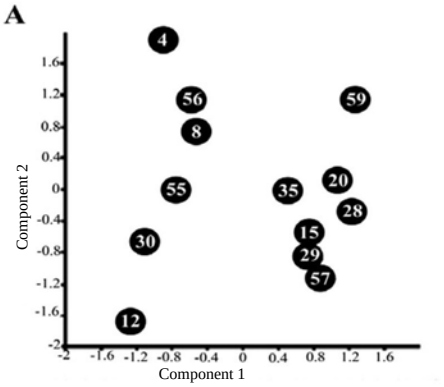


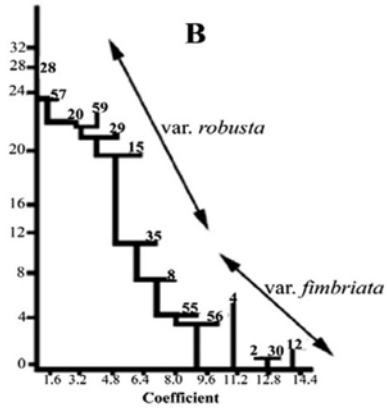
Fig. 4. Scanning electron micrographs of leaf surfaces of *Acalypha fimbriata* var. *robusta* Kadiri **var. nov.** A – F: Abaxial surface; G – H: Adaxial surface (warty surface of trichomes are in E and G).

Table 3. Distinctive morphological characteristics of the recognized infra-specific taxa of *Acalypha fimbriata* in Nigeria.

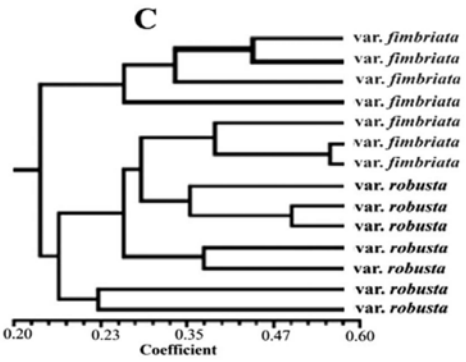
Characters	*Acalypha fimbriata* var. *fimbriata*	*Acalypha fimbriata* var. *robusta* **var. nov.**
Inflorescence number	2 – 16	27 - 35
Pistil number per bract	1	2
Cuticular characters	Wide stomatal rim	Thin stomatal rim
	Narrow-short stomatal aperture	Wide-long stomatal aperture
	Smooth unicellular conical trichome	Warty unicellular conical trichome



Principal component analysis showing the two varieties identified. The figures are the populations' accession numbers.



Neighbour joining analysis using Euclidean similarity measures.



A UPGMA dendrogram showing relationships among the populations.

Fig. 5. Relationships among the studied populations of *Acalypha fimbriata*. 5A. Division of the populations supported by principal component analysis; 5B. Neighbour joining dendrogram showing the separation of the populations; 5C. UPGMA tree showing the pattern of relationships among the populations of *Acalypha fimbriata*.

Most of the populations used in the study are from southwest Nigeria where Hutchinson and Dalziel (1958) implicated as the most probable centre of genetic diversity for most species of *Acalypha* in West Africa. The characters used for analysis have been reported by Hutchinson and Dalziel (1958) and Agnew (1974) to be taxonomically useful in the genus. In corroboration, Davis and Heywood (1963) stated that morphology is a pedestal upon which taxonomic decisions are based. Although, cuticular characters of the leaf surface are not discriminating enough to support the groups recognized, however, presence of warty and long unicellular trichome and thin stomatal rim recorded in the var. *robusta* Kadiri var. nov. distinguish it from the var. *fimbriata*. Stomatal and trichome characters are useful for delimitation of taxa (Stace, 1965; Inamdar and Gangdhara, 1977; Metcalfe and Chalk, 1979; Devi *et al.*, 2013), which has been supported by the present study. The statistical analyses of principal component analysis, neighbour joining analysis and UPGMA dendrograms also reflect the level of relationships among the populations and support recognition of the two distinct groups i.e. varieties in *Acalypha fimbriata.*

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