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Evaluation of Diagnostic Vegetative and Reproductive Characters Among *Abrus* Species in Nigeria

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Abstract: Studies were undertaken on the vegetative and reproductive characters of *Abrus* species (*A. canescens*, *A. precatorius*, *A. pulchellus* and a new collection identified as *Abrus* sp.) in Nigeria to establish relatedness or not of species, and identify characters of diagnostic importance. Thirty characters (21 quantitative and 9 qualitative) were compared. The quantitative characters were subjected to Anova and schiffe test of comparison of means after initial measurements. The results show that *A. pulchellus* is more related to the new collection than the other two species in number of pairs of leaflet, leaflet length and width, and number of fruit per peduncle. Similarly, affinity is high between *A. precatorius* and *A. canescens* in number of pairs of leaflet, leaflet length and width. *A. pulchellus* is distinct with its pinkish flowers while the red and black seeds of *A. precatorius* are diagnostic. The diagnostic characters among the species include leaf type (even- or odd-pinnate), leaflet length, number of pairs of leaflet, flower colour, fruit shape and number of fruits per peduncle.

Key words: *Abrus,* morphological characters, Nigeria

INTRODUCTION

The taxonomy of *Abrus*, a small pantropical genus, is somewhat controversial. Bretler (1960) and Verdcout (1970, 1971) recognized four and thirteen species respectively. One species *A. longibracteatus* Labat was described by Labat (1991) from Laos and Vietnam while Thulin (1994) described two recent species – *A. baladensis* Thulin and *A. gawenensis* Thulin – from fixed sand dunes and sand over limestone respectively in Mogadishu, Somalia. In West Africa, Hutchinson and Dalziel (1958) described three species viz: *A. canescens* Welw. ex Bak., *A. pulchellus* Wall. ex Thw. and *A. precatorius* L. These three species occur in Nigeria. The species of *Abrus* are characterized by slender woody twinners with pinnate leaves, rachis ending in a bristle, stamens connate in a sheath with racemose flowers. Medicinal, pharmacological and toxicological properties and uses are ascribed to the West African species (Bouquet and Debray, 1974; Burkill, 1995).

Abrus species in Nigeria exist mostly in jungles, galleried forests and sacred groves. These forests are fast disappearing due to deforestation and other anthropogenic impacts related to industrial development. The net effect is the gradual reduction in the population and distribution of *Abrus* species and their eventual extinction. This scenario is demonstrated by the inability to re-collect *A. canescens* from locations where it was previously reported to occur after several field trips; thus only herbarium samples from Forestry Herbarium Ibadan (FHI) and University of Ibadan Herbarium (UIH) were used for this study. The vegetative parts (leaves and stems) of the species are variable and plastic, showing marked overlap in their characteristics, thereby making their sole usage in species identification difficult. This is exacerbated by the fact that floral characters used by Hutchinson and Dalziel (1958) to describe the two common species, *A. precatorius* and *A. pulchellus*, did not match with fresh collections made in Nigeria between 1998 and 2002. Hutchinson and Dalziel (1958) descriptions were probably based on herbarium specimens, which might not have been properly documented by the initial collectors. Since the usefulness of macromorphological characters including floral or reproductive and vegetative features cannot be overemphasized (Davis and Heywood, 1973; Metcalfe and Chalk, 1979; Stace, 1980; Akpabio and Olorode, 1988), the present study approaches the taxonomy of the *Abrus* species in Nigeria from both qualitative and quantitative morphological description with statistical comparisons. On account of the identified threats to *Abrus* diversity in Nigeria, lack of taxonomic documentation and the potentials the species hold in ethnomedicine, systematic studies commenced recently on the genus

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(Agbagwa and Okoli, 2005a and 2005b; Agbagwa and Okoli, 2006; Agbagwa *et al.,* 2007; Agbagwa and Obute 2007). These studies are targeted at proper identification and planning for conservation of the species. Solving the problem of physical identification of the individual species by interested researchers on this genus is possibly sine qua non to their conservation.

MATERIALS AND METHODS

Observations on vegetative and floral characteristics were made on mature plants growing in the wild from different localities and their F_2 counterparts planted in the University of Port Harcourt Botanical Garden, and specimens previously identified, preserved and deposited in Forestry Herbarium Ibadan (FHI) and University of Ibadan Herbarium (UIH) (Table 1). A 30cm ruler was used to measure the length, breadth dimensions of leaves, seeds, fruits, flowers and other floral parts. Photographs of relevant morphological features were taken and drawings made where necessary.

In all, sixty-five samples (Table 1) of the three *Abrus* species and the new collection comprising fifteen fresh samples collected from around Nigeria and fifty herbarium samples collected from Nigeria and some neighbouring West African countries and deposited in UIH and FHI were assessed and compared. The samples with codes A-1 to A-26 for *A. precatorius*, B-1 to B-14 for *A. pulchellus,* C-1 to C-22 for *A. canescens* and D-1 to D-3 for *Abrus* sp. were compared in twenty-one quantitative and nine qualitative characters (Table 2).

Statistical Analysis:

Statistical analysis of the variation in quantitative attributes of twenty-one characters between the species to ascertain the extent of taxonomic variation was undertaken using a single factor Analysis of Variance (ANOVA). Three characters (number of pairs of leaflet, length and width dimensions of leaflet) were compared between samples of the same species collected from different parts of the country. Together with seven other characters (rachis length, internode length, number of fruits per peduncle, fruit length, number of seeds per fruit, stamen and style lengths) comparisons between species from fresh collections and herbarium specimens were made.

The ANOVA results were subjected to further confirmatory analysis using the Schiffe test of confirmation of association (Ukwuije, 1994). This was to confirm whether or not:

- The observed similarities or differences in characters found between species are taxonomically significant or not.
- To identify characters that differed; their level of variation, association or relationship between species, and identify the closest species.

RESULTS AND DISCUSSION

Results:

Habit:

The morphological appearances of the three species and the new collection are presented in Figures 1 – 4. The results showed that four distinct species of *Abrus* occur in Nigeria. Three of these (*A. canescsens, A. precatorius* and *A. pulchellus*) were previously described by Hutchinson and Dalziel (1958) in their Flora of Tropical West Africa, while the forth species, was recently collected by the author from the Taylor Creek Forest in the Niger Delta. This species is referred to in this work as *Abrus* sp.

Results of quantitative and qualitative characters among the species are presented in Table 2. Based on these results, the overall similarity between *A. pulchellus* and the new collection *Abrus* sp. is high in number of pairs of leaflet, leaflet length and width, and number of fruit per peduncle. Similarly, affinity is high between *A. precatorius* and *A. canescens* in number of pairs of leaflet, leaflet length and width dimensions (Table 2).

Number of Pairs of Leaflet:

The number of pairs of leaflet varied within fresh collections of *A. precatorius* (A-1 to A-6) and *A. pulchellus* (B –1 to B-6) at $F_{0.05}$ (5, 54). The mean number of pairs of leaflet for *A. precatorius, A. pulchellus* and *Abrus* sp. are 13 ± 1.41, 8± 1.23, and 6± 0.70 respectively (Table 2). ANOVA showed that differences in mean number of pairs of leaflet between these species were significant $F_{0.05}$ (2, 19) = 190.2. Schiffe test of confirmation of association confirmed this significant difference (Table 3a) and showed that *A. pulchellus* is related to *Abrus* sp. in number of pairs of leaflet than to *A. precatorius*. However, the observed significant

Table 1: Sources, Collection Localities, Collectors and Codes of *Abrus* Species studied

Taxa	Code of species	Collector and sample identity number	Collection Date	Locality	Remarks
Abrus precatorius	A – 1	Agbagwa 001	17/5/98	Emeabiam, Owerri West L. G. A., Imo State	In a sacred grove/shrine
	A – 2	Agbagwa 002	15/8/98	Orazi road, Port Harcourt. Climbing on a barbed fence	Growing as escape
	A – 3	Agbagwa 010	2/8/99	Forestry Research Institute of Nigeria (FRIN), Ibadan	Ornamental
	A – 4	Agbagwa 005	16/1/99	69 Independence Layout, Enugu.	In private compound
	A – 5	Agbagwa 008	4/4/99	Umuna, Okigwe, Imo State	Secondary forest
	A – 6	Agbagwa 011	12/12/99	Ibiono Ibom, Akwa Ibom State	Tropical rainforest
	A – 7	E. Bernays UIH 16216	8/4/75	Iwo Road, Ibadan (½ mile from New Ife road)	
	A – 8	Williamson R. UIH 15402	14/12/73	Kaiama, Kolokuma Area Yenegoa Division	
	A – 9	D. Vermeer. UIH 16712	1975	W. of J. W. Donga, Benue Province,	7o15'N 9o40'E
	A – 10	C. Onochie. FHI 35922	20/7/57	Gwari, Gawu Hills	
	A – 11	Olurunfemi FHI 57085	26/9/66	Kabama forest reserve, Zaria	
	A – 12	Magaji FHI 17962	15/9/67	Seven Miles on 6/7 range Runka Forest Reserve, Katsina. On savanna woodland	
	A – 13	C. Onochie FHI 7194	22/4/44	Umuikem, Onitsha	
	A – 14	Daramola & Ihe FHI 85167	25/5/78	Ondo, in a *Cacao* Plantation.	
	A – 15	Oduwo & Daramola FHI 85297	23/1/78	Odofin, Agbeji village, Ikire district, Oyo state	
	A – 16	FHI 98709	17/9/77	Northern Province, Karonga District, Mali Vinthukhutu 2 miles North of Chilumba 1800ft	Republic of Mali
	A – 17	Adam (377) FHI 84029	21/1/48	M'Bao, Rufisque District, Senegal Rep	Republic of Senegal
	A – 18	Jones (2943) FHI 6914	2/3/43	Uguoka, Awka District, Onitsha.	
	A – 19	Jones FHI 16649	24/3/46	Grace Camp Shasha (Omo) FR, Ijebu-Ode	
	A – 20	Ekwuno, Osanyinlusi, Okoro FHI 92738	15/2/80	Gashaka G. R.	
	A – 21	Daramola FHI 78539	20/9/75	Creek edge near New Prisons Calabar, S. E.	
	A – 22	Emwiogbon, Osanyinlusi FHI 87127	6/10/77	Savanna woodland on roadside, Obudu Ogoja road	
	A – 23	D. Gledhill (794) UIH 10244	10/2/68	University Compound Ibadan	Wrong identification = *A pulchellus*
	A – 24	J. Lowe UCI 258A	4/11/49	Mile 104 Lagos-Ibadan Road, Ibadan	Wrong identification = *A pulchellus*
	A – 25	(198) UIH 2099	14/11/31	Farmland vegetation, Umuahia	Wrong identification = *A pulchellus*
	A – 26	Gbile and Olorunfemi UIH 12498	7/11/68	Ogba River, Okeho Road, Western State	Wrong identification = *A canescens* FHI 20444.
Abrus pulchellus	B – 1	Agbagwa 003	21/12/98	Emeabiam, Owerri – West L. G. A., Imo State	Riparian forest
	B – 2	Agbagwa 004	6/01/99	Behind Chemical Engineering Dept. Choba, Uniport	Forest regrowth
	B – 3	Agbagwa 006	12/2/99	After the Mosque, University of Ibadan Nigeria.	Secondary forest
	B – 4	Agbagwa 007	1/3/99	Calabar, Nigeria	
	B – 5	Agbagwa 009	3/5/99	KM 4, along Kolo-Creek/ Rumuekpe Pipeline, Imiringi, Bayelsa State	Tropical rainforest
	B – 6	Agbagwa 012	29/11/2000	High Secondary forest, opposite IITA office, Onne Station	High forest
	B – 7	Latilo FHI. Bret 1961	1/3/61	Acharane F. R., Idah District, Kabba	

Table 1: Continued

	B – 8	Ujor E. FHI 29395	22/11/51	Gambari South F.R. Ibadan.	
	B – 9	Gbile, Olorunfemi, Binuyo FHI 20588	7/2/69	Ogbesse River Bank Ogbesse-Owo Rd; Owo Ondo. Det. As *A. pulchellus* Wall 6/3/09, *A. fruticulosus* Wall. Ex. W. & A. 1/11/61; *A. pulchellus* Thro. Spp. 1/4/71.	Det. As *fruiticulosus* wall. Ex wight et Arn. & *A. pulchellus* wall respectively at Kew.
	B – 10	Onochie PSP 132 FHI 43187	16/11/58	Akpaka F. R. Onitsha Det. As *A. fruticulosus* Wall. Ex wight et Arn. & *A. pallchellus*Wall. Respectively at Kew.	
	B – 11	Olatilo FHI 60847	1/12/66	Aiyeto, Meko Savanna woodland, Abeokuta.	
	B – 12	Jones FHI 6359	11/10/43	Oyo	Seen for revised edition of F. W. T.A.
	B – 13	Emwiogbon FHI 43539	14/11/61	Shasha F.R, Oyo, Ife District	
	B – 14	Emwiogbon FHI 65800	7/10/72	Osumare East FR, Ihiala District, E. central	Det. As *A. fruticulosus*wall ex wight et Arn. 31/11/73
Abrus canescens	C-1	Meikle (1089) UIH 2098	21/1/50	Kontagora Division by roadside, about 4k from Kontagora	Savanna
	C-2	Gbile & Olurunfemi FHI 20444 UIH 12498	15/10/68	Ogba River, Okeho Road, Iseyin District, Oyo Western State	
	C-3	Olurunfemi Binuyo, Babagbemi FHI 96811	23/11/81	Iyere-Ogura Road, Owo District, Ondo State.	Cited specimen F. W. T. A. Ed. 2, 1958
	C-4 FHI 37913	Keay & Stanfield	26/959	Oyo: 3 miles South of Oyo by Ilora turn	
	C-5	Latilo FHI 62268	14/11/68	Egbe, Yagba District of Kabba, Kwara State.	
	C-6	Stanfield FHI 40015	6/10/57	Owo	
	C-7	Latilo FHI 64726	3/12/71	North East, Bauchi about 10 miles east of Aliya village in Ngeji village	
	C-8	Eimunjeze & Oguntayo FHI 71358	8/10/74	Savanna – woodland, beside a stream, Omu-Aran, Kwara State.	
	C-9	Ohaeri (1037) FHI 78891	20/10/75	Shika farm, Zaria	
	C-10	Daramola & Adebisiyi FHI 38433	14/10/58	On the line 15, Savanna woodland area, Bunu District, Kabba	
	C-11	Eimujeze & Oguntayo FHI 72813	17/10/74	Bank of a stream, Ndeji, Lafiagi /Pategi District	
	C-12	Opayemi (095) FHI 68859	18/11/72	5 miles after Oyo on Iseyin Road; savanna near a stream.	Savanna
	C-13	FHI 77678 Photo No. 1723	1855	Angola No. 2249	TYPE SPECIMEN: TYPE OF BRITISH MUSEUM HERBARIUM
	C-14	Olurunfemi Oguntayo, Ihe (344) FHI 88564	6/10/78	Ajadis camp, illorin district, Kwara State	Savanna area
	C-15	Olurunfemi Oguntayo, Ihe FHI 88468	3/10/78	Kabba – Ogidi Road, Oyi District, Kwara State	Savanna area
	C-16	Olurunfemi Oguntayo, Ihe FHI 88335	20/9/78	Savanna: Ogamnana – Lokoja Road, Okene, Kwara State.	as *A. frutensis*
	C-17	Latilo FHI 73554	10/11/75	Baissa – Mararraba Road, North Eastern State.	Savanna area
	C-18	Mullenders (248) FHI 42593	1/4/47	Kaniama-Haut Lomani (Congo Belge)	Specimen from Ex Herbario Horti Botanici Yangambiensis. (Congo Belge)
	C-19	Amshoff FHI 31707	1972	Near Sindou, 5 11Wo, 10 49No, Upper Volta	Presently Burkina Faso Specimen from Plantae Upper Volta. exsiccatae Herbarium vadense
	C-20	Rwaburindore (1141) FHI 104671	20/1/83	Kanyanya Valley, W. Mengo District Kyadondo District of Uganda. Lat Oo23N long. 32o 36'E. Altitude 1200M	Uganda Flora of Uganda

Table 1: Continued

	C-21	Adams & Akpabla (4394) FHI 53186	18/12/50	Climbing on shrubs near swamps: from Ghana Herbarium	Cited F. W. T.A. ed. 2, 1.574
	C-22	Morton (2482) FHI 14626	14/11/65	Kameron to Kuruboula, about 2 miles from Kameron	In damp savanna in Kameron.
Abrus sp.	D – 1	Agbagwa 013	1/12/2000	Taylor Creek area, Biseni, Bayelsa State	High tropical rainforest area.
	D - 2	Agbagwa 014	1/12/2000	Samabri-Biseni Cluster, Bayelsa State	High tropical rainforest
	D - 3	Agbagwa 015	10/01/2001	Taylor Creek area, Biseni, Bayelsa State	High tropical rainforest area.

Table 2: Summary of Morphological and Macromorphometric Characters in *Abrus* species

	Characters	*A. precatorius*	*A. pulchellus*	*A canescens*	*Abrus* sp.
1.	Duration & habit	Perennial sub-woody twinning shrub.	Perennial woody scrambling shrub	Perennial subwoody robust twinner	Perennial woody climber
2.	Stem	Strong, greenish round up to 1cm thick	Brown-black, moderately strong, elastic, rooting at node	Strong, brown and very pubescent.	Brown-black sparingly pubescent.
3.	Leaf type	Pinnate (even-pinnate)	Even pinnate	Even Pinnate	Even pinnate; occasionally odd – pinnate
4.	Leaf surface	Slightly pubescent on both surfaces	Pubescent on both surfaces	Very pubescent with silvery to rusty brown hairs on both surfaces	Glabrous on both surfaces with prominent venation on lower surface.
5.	Number of pairs of leaflet				
	Range	11 – 15	5 – 10	7 – 13	5 – 7
	Mean	13 ± 1.41	8 ± 1.23	11 ± 1.48	6 ± 0.70
6.	Leaflet dimensions (cm) i. Length				
	Range	0.80 – 2.20	0.70 – 3.90	0.60 – 2.30	1.90 – 4.60
	Mean	1.40 ± 0.35	2.20 ± 0.81	1.35 ± 0.43	3.10 ± 0.64
	ii. Breadth				
	Range	0.30 – 1.00	0.40 – 2.00	0.30 – 0.90	1.00 – 2.00
	Mean	0.62 ± 0.18	1.10 – 0. 34	0.54 ± 0.12	1.46 ± 0.30
7.	Leaflet shape	Oblong (except last pair which is obovate); rounded to emarginate and smooth at apex, rounded to acute at base	Oblong except last pair), rounded to truncate and smooth at apex, rounded to obtuse at base	Narrowly oblong or oblong-lanceolate (except last pair) round and smooth at apex, rounded to obtuse at base	Oblong-elliptic (except last pair), rounded to truncate at apex, rounded at base
8.	Rhachis length (cm)				
	Range	4.80 – 12.00	3.20 – 10.00	3.80 – 8.70	4.50 – 8.60
	Mean	7.76 ± 1.96	7.10 ± 1.62	5.68 ± 1.15	6.84 ± 1.44
9.	Petiole length (cm)				
	Range	0.10 – 0.30	0.20 – 0.40	0.10 – 0.40	0.30 – 0.50
	Mean	0.20 ± 0.05	0.34 ± 0.07	0.24 ± 0.06	0.40 ± 0.09
10.	Petiole (cm)				
	Range	0.05 – 0.10 occasionally ≤ 0.05	0.05 – 0.10	0.05 – 0.10 occasionally < 0.05	0.10 – 0.20
	Mean	0.05 ± 0/20	0.09 ± 0.03	0.07 ± 0.03	0.12 ± 0.03
11	Internode length (cm)				
	Range	3.40 – 10.50	4.20 – 10.00	-	6.00 – 12.50
	Mean	5.20 ± 1.27	7.05 ± 1.85	-	10.10 ± 2.50
12.	Phylotaxy	Alternate	Alternate	Alternate	Alternate
13.	Stipule				
	Range	0.20 – 0.30	0.10 – 0.40	0.10 – 0.30	0.20 – 0.40
	Mean	0.26 ± 0.05	0.24 ± 0.08	0.29 ± 0.06	0.30 ± 0.07
14.	Stipulae length (cm)				
	Range	≤ 0.05	0.05 – 0.10	0.05 – 0.10 mostly ≤ 0.05	0.10 – 0.20
15.	Inflorescence	Raceme, axillary, clustered flowers with short pedicel	Raceme, axillary, flowers not in cluster.	Raceme axillary, flowers not in culsters	Raceme, axillary, flowers occur as distant or separated clusters on the peduncle.
16.	Flower	Purple	Dull white to pink	Purple	Light purple
17.	Aestivation	Vexillary	Vexillary	-	Vexillary
18.	Pedicel				
	Range	0.10 – 0.20	0.10 – 0.30	-	0.10 – 0.15
	Mean	0.18 ± 0.12	0.22 ± 0.06	-	0.13 ± 0.02

Table 2: Continued

19.	Calyx length (cm)				
	Range	0.30 – 0.50	0.20 – 0.50	-	0.30 – 0.50
	Mean	0.40 ± 0.05	0.33 ± 0.08	-	0.40 ± 0.07
20.	Stamen length (cm)				
	Range	1.00 – 1.40	0.40 – 1.00	-	1.20 - 1.40
	Mean	1.15 ± 0.11	0.71 ± 0.15	-	1.34 ± 0.07
21.	Corolla dimensions (cm)				
	i. Length				
	Range	0.70 – 1.30	0.70 – 1.00	-	1.20 - 1.40
	Mean	1.11 ± 0.20	0.84 ± 0.09		1.30 ± 0.10
	ii Breadth				
	Range	0.20 – 0.90	0.20 - 0.80	-	0.20 – 0.80
	Mean	0.51 ± 0.26	0.43 ± 0.23		
22.	Style length (cm)				
	Range	1.10 - 1.40	0.50 - 1.00	-	1.50 – 0.10
	Mean	123 ± 0.08	0.76 ± 0.13	-	1.70 ± 0.10
23.	Fruit	Pod black at maturity, oblong, raised, warty with rough surface and down-curved beak	Pod brown at maturity, flat, oblong to nearly sickle shaped with a down-curved beak.	Pod brown, mucronate, flat and straight with down curved beak	Pod flat, oblong with straight (not down curved sharp pointed beak. Brown.)
24.	Number of fruit/peduncle				
	Range	4 – 25	1 – 6	1 – 6	1 – 6
	Mean	12 ± 6.24	2 ± 1.30	2 ± 0.80	3 ± 1.50
25.	Fruit dimension (cm)				
	i. Length				
	Range	1.20 – 4.00	1.10 - 3.80	3.20 - 6.00	3.00 - 5.00
	Mean	2.80 ± 0.74	2.96 ± 0.50	4.20 ± 1.0	4.20 ± 0.40
	ii. Breadth				
	Range	1.00 - 1.40	0.50 - 1.00	0.40 - 1.40	1.00 - 1.30
	Mean	1.20 ± 0.12	0.80 ± 0.10	0.90 ± 0.20	1.21 ± 0.12
26.	Seed	Egg-shaped, black around the hilium, red on the other parts	Flat or occasionally slightly raised smooth, brown and mottled.	Flat smooth and black	Flat or occasionally raised, brown at maturity.
27.	Number of seed/fruit				
	Range	2 – 6	2 – 6	5 – 10	3 – 8
	Mean	4 ± 1.02	4 ± 1.04	7 ± 1.0	7 ± 1.51
28.	Seed dimensions (cm)				
	i. Length				
	Range	0.30 - 0.50	0.30 - 0.50	-	0.60 – 0.80
	Mean	0.44 ± 0.03	0.50 ± 0.50	-	0.70 ± 0.10
	ii. Breadth				
	Range	0.20 - 0.40	0.20 - 0.30	-	0.40 – 0.50
	Mean	0.34 ± 0.05	0.30 ± 0.04	-	0.42 ± 0.04
29.	Hilium length (cm)				
	Range	0.15 – 0.20	0.40 - 0.70	-	0.29 – 0.30
	Mean	0.20 ± 0.02	0.50 ± 0.10	-	0.29 – 0.30
30.	Root	Napiform with lateral branches producing few root modules	Napiform with clusters of root nodules of varying sizes.	-	-

Table 3a: Number of pairs of leaflet Fcrit =3.52

Code	A	B	D
A	00	14.45	24.49
B		00	8.37
D			00

Table 3b: Number of Pairs of Leaflet Herbarium samples of *A. precatorius* Fcrit = 2.14

Code	A-7	A-8	A-9	A-11	A-12	A-13	A-23	A-25
A –7	00	0.48	0.34	0.55	0.55	2.24	2.17	2.14
A – 8		00	0.10	0.99	0.99	0.21	1.72	1.69
A – 9			00	0.90	0.90	0.10	1.83	1.79
A – 11				00	0.00	0.79	2.72	2.69
A – 12					00	0.79	2.72	2.69
A – 13						00	1.93	1.89
A – 23							00	0.03
A - 25								00

Fig. 1: *A. precatorius* twig showing leaves, flowers and fruit.

(a) **(b)**

Fig. 2a: *A. pulchellus* twig showing the leaves and inflorescence with flowers and flower buds
Fig. 2b: One of the herbarium specimens A. pulchellus at FHI. Notice the flat fruits on the inflorescence.

differences $F_{0.05}$ (2, 22) = 118.60 in the mean number of pairs of leaflets between herbarium samples of *A. precatorius*, *A. pulchellus* and *A. canescens*, could not be confirmed with further test of comparison and association of means (Schiffe Test); rather among *A. precatorius* herbarium samples the observed differences in number of pairs of leaflets at $F_{0.05}$ (7,72) = 824.50 were confirmed between samples A-7 and A-13, A-7 and A-23, A-11 and A-23, A-11 and A-25, A-12 and A-23, A-12 and A-25 only (Table 3b).

Leaflet Length:

Significant differences were observed in the mean leaflet length within fresh samples of *A. precatorius* and *A. pulchellus* at $F_{0.05}$ (5, 54) in both cases and confirmed using Schiffe test (Tables 4a & 4b). Similarly, differences observed between the mean leaflet length of fresh samples of *A. precatorius, A. pulchellus* and *Abrus* sp. using ANOVA (Table 2) were confirmed by the Schiffe method to be significant.

Observed ANOVA results show that significant differences exist in leaflet length within the individual herbarium samples of *A. precatorius* and *A. canescens.* Schiffe test confirmed the differences (Tables 4c & 4d). Differences in *A. canescens* samples occurred only between samples C-1 and C-19, C-2 and C-19, C-7 and C-19.

Differences in mean leaflet length between herbarium samples of *A. precatorius, A. pulchellus* and *A. canescens* were observed to be significant with ANOVA. However, these differences could not be confirmed using Schiffe test.

Table 4a: *A. precatorius* - Leaflet Length (F crit = 2.39)

Code	A -1	A - 2	A - 3	A - 4	A - 5	A – 6
A – 1	00	-0.25	1.75	-2.5	-7.00	-2.75
A – 2		00	2.00	-2.25	-6.75	-2.5
A – 3			00	-4.45	-8.75	-4.15
A – 4				00	-4.5	2.25
A – 5					00	4.25
A – 6						00

Table 4b: *A. pulchellus* - Leaflet Length (F crit = 2.39)

Code	B-1	B-2	B-3	B-4	B-5	B-6
B-1	00	1.70	1.80	2.44	0.06	1.76
B-2		00	0.10	0.75	1.76	0.06
B-3			00	0.64	1.86	0.04
B-4				00	2.50	0.68
B-5					00	1.82
B-6						00

Table 4c: *A. precatorius* - Leaflet Length (Herbarium samples) F crit = 2.14

Code	A-7	A-8	A-9	A-11	A-12	A-13	A-23	A-25
A –7	00	-1.52	1.03	1.69	1.52	1.03	2.34	3.97
A – 8		00	2.55	3.21	3.04	0.49	0.82	2.45
A – 9			00	0.65	0.49	2.07	3.37	4.99
A – 11				00	0.16	2.72	4.02	5.65
A – 12					00	2.55	3.86	5.49
A – 13						00	1.30	2.94
A – 23							00	1.63
A - 25								00

Table 4d: *A. canescens* Leaflet Length (Herbarium samples) F crit = 1.88

Code	C1	C-2	C-3	C-4	C-5	C-9	C-7	C-18	C-19	C-20	C-21	C-22
C-1	00	0.32	1.43	1.61	0.94	1.82	0.11	1.71	2.45	0.29	1.08	0.66
C-2		00	1.12	1.29	1.29	0.63	1.50	-0.21	1.40	2.13	1.50	0.77
C-3			00	0.18	-0.49	0.39	-1.33	0.28	1.01	0.38	-0.35	-0.77
C-4				00	-0.66	0.21	-1.50	0.03	0.84	0.21	-0.52	-0.94
C-5					00	0.87	0.84	0.77	1.50	0.87	0.14	-0.25
C-9						00	-1.71	-0.11	0.63	0.00	-0.73	-1.15
C-7							00	1.61	2.34	1.71	0.98	0.56
C-18								00	0.73	0.11	-0.63	-1.05
C-19									00	-0.63	-1.36	-1.78
C-20										00	-0.73	-1.15
C-21											00	-0.42
C-22												00

Leaflet Width:

Significant differences in mean leaflet width within fresh samples of *A. precatorius* and *A. pulchellus* and between *A. precatorius*, *A. pulchellus* and *Abrus* sp. were observed Schiffe confirmatory test showed that these differences were not significant between the species (Table 5a).

Except with samples of *A. pulchellus,* significant differences were observed within samples of *A. precatorius* and *A. canescens* using ANOVA. Schiffe test show that much significant differences occur among the leaflet width of the individual samples of the three species. However, while the observed ANOVA result of the mean leaflet width $F_{0.05}$ (2, 22) = 1.0 between the herbarium samples of the 3 species were significantly different, Schiffe confirmatory test showed no difference (Table 5b).

Table 5a: Leaflet Width - fresh samples of *A. precatorius* (A), *A. pulchellus* (B) *and Abrus* sp. (D) F crit = 3.52Code

	A	B	D
A	00	-10.63	14.68
B		00	-6.67
D			00

Table 5b: Leaflet Width - herbarium samples of *A. precatorius* (A), *A. pulchellus* (B) *and A. canescens (*C)

	A	B	C
A	00	0.16	0.06
B		00	0.20
C			00

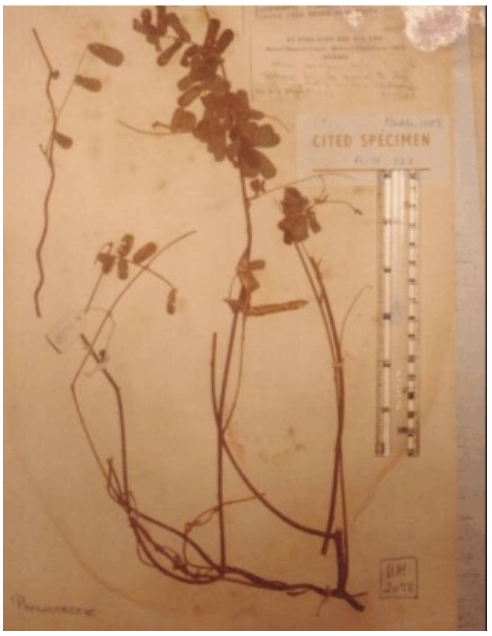


Fig. 3: *A. canescens.* A herbarium specimen cited in Flora of West Tropical Africa, Ed. 2, 1958

Rachis and Internode Length:

The observed differences in rachis and internode lengths between fresh samples of *A. precatorius, A. pulchellus* and *Abrus sp.* (Table 2) were not significant using ANOVA at $F_{0.05}$ (2, 19) = 37.80 and $F_{0.05}$ (2, 19) = 158.40 respectively, and Schiffe test.

Number of Fruits per Penduncle, Fruit Length and Number of Seeds per Fruit:

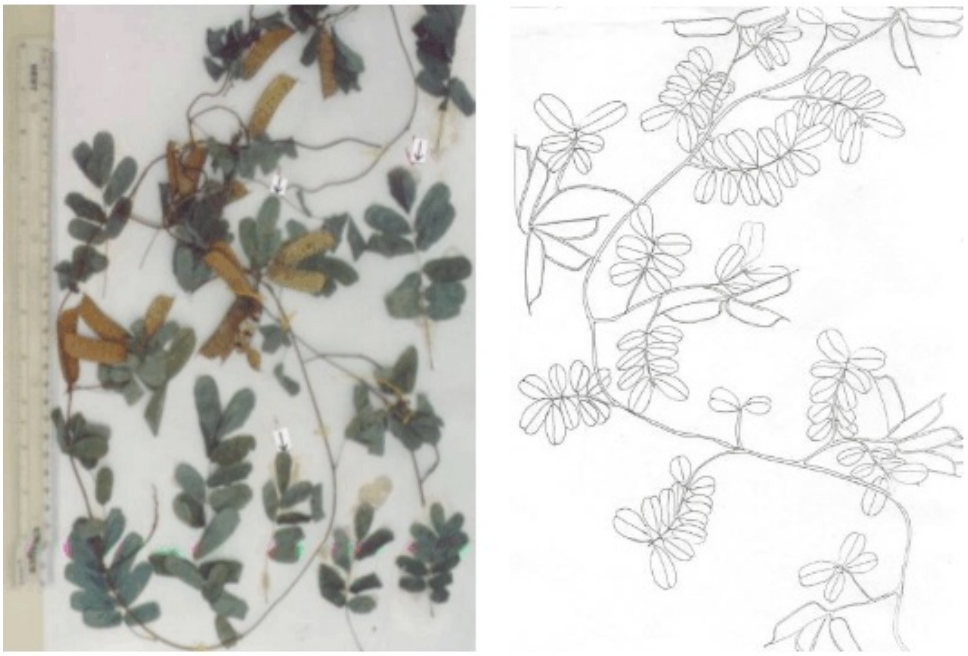
ANOVA showed that differences in the mean number of fruits per penduncle and fruit length (Table 2) between fresh collections of *A. precatorius, A. pulchellus* and *Abrus sp*. were significant. The observed results were confirmed significant with Schiffe test. *A. precatorius* specifically differs from the other species in mean number of fruits per peduncle with the highest value of 12±6.24. *A. pulchellus*, *A. canescens* and *Abrus* sp. are however similar (Table 2). Similarity was also observed between *A. precatorius* and *A. pulchellus*, *A. canescens* and *Abrus* sp. in fruit length. Similarly, affinity was observed between *A. precatorius* and *A. pulchellus*, *A. canescens* and *Abrus* sp. in number of seeds per fruit. The highest number of seeds per fruit occurs in *A. canescens.*

***Stamen and Style Length*:**

Results show that *A. pulchellus* differs from *A. precatorius* and *Abrus* sp. in stamen and style length (Table 2). The differences observed using ANOVA between the species were further confirmed significant using Schiffe test. *A. precatorius* and *Abrus* sp. are however similar in both characters.

Discussion:

Based on the results of this study, four species of *Abrus* are recognized occurring in Nigeria, three of which have been reported by Hutchinson and Dalziel (1958), and a new collection, whose identify does not match any of the previously reported species. This new collection is undergoing nomenclatural studies. Observed differences and variation in the number of pairs of leaflets among fresh and herbarium samples of



(a) **(b)**

Fig. 4a: Habit of the new collection, Abrus sp. Notice the fruits with re-curved beak. Arrow points to odd-pinnate leaves

Fig. 4b: A diagram of the new collection showing leaf and fruit characteristics

the same species were not significant (P≤0.05) following Schiffe test of comparison. These differences were observed to have arisen from wrong identification of herbarium specimen, environmental separation of species in space (Soromessa *et al.,* 2004) and other edaphic factors, which could lead to low leaflet numbers when conditions are not favourable. This is clearly demonstrated with the following herbarium specimens of *A. precatorius* in Table 1: A-7 (Iwo Road Ibadan, western Nigeria) and A-13 (Umuikem Umuahia, eastern Nigeria), A-7 and A-23 (*A. pulchellus* collected from University of Ibadan compound and wrongly identified as *A. precatorius*), A-11 (Kabama Forest Reserve, Zaria-northern Nigeria) and A-23 (wrong identity), A-11 (Zaria) and A-25 (Umuahia, eastern Nigeria), A-12 (Katsina, northern Nigeria) and A-23 (wrong identity). Therefore, number of pairs of leaflet is not a good character for comparing samples of the same species collected from different geographical locations. Ugborogho (1978) opined that such vegetative characters are under environmentally conditioned changes, which render their utility for taxonomic purposes inadequate. However, interspecific differences in number of pairs of leaflet between *A. precatorius, A. pulchellus* and *Abrus* sp. fresh samples observed with ANOVA at P£0.05 were confirmed to be significant. Thus while number of pairs of leaflet may not be of taxonomic importance within samples of the same species, it could be diagnostic for delimitation of species. Even with the recorded significant difference in mean number of pairs of leaflets, differences in rachis length between fresh collections of *A. precatorius, A. pulchellus* and *Abrus* sp. (Table 2) were not significant at £0.05 using Schiffe test. With distinct mean value of 13 ± 1.41 for the number of pairs of leaflet in *A. precatorius,* significant difference was expected in rachis length between the species. However, the length and width dimensions of the leaflets, which were significantly different between the three species, gives an insight and provide explanation to the lack of difference in rachis length. In each character situation (length and width), *A. pulchellus* and *Abrus sp.* were observed to have higher leaflet dimensions than *A. precatorius* mean values. Therefore the extra number of pairs on the rachis of *A. precatorius* was compensated by the large leaflets of *A. pulchellus* and *Abrus sp.* Leaflet is therefore a good taxonomic character for species separation in *Abrus.* However, significant differences of sort at P £ 0.05 in leaflet dimensions occurred within some samples (same species) of *A. precatorius* and *A. pulchellus*. This is expected because Bjorkquist (1967), Ugborogho (1978) and Stace (1980) have pointed out that modification of such vegetative character as leaf

dimensions by the environment is possible. Since different regions or states may show differences in climatic/environmental factors, collections made from these areas as shown in Table 1 may also differ in some vegetative characters. For instance, differences occurred in leaflet dimensions of samples A-1 and A-3 of *A. precatorius* (collected from Imo and Oyo States, in the eastern and western areas of Nigeria respectively) and B-1 and B-4 of *A. pulchellus* (collected from Imo and Cross River States in the eastern and south-southern areas of Nigeria respectively).

The differences observed in internode length among fresh samples of *A. precatorius, A. pulchellus* and *Abrus sp.* were not significant. However, the number of fruits per peduncle as well as the fruit length was confirmed to be significantly different within the species (P £ 0.05). The differences in number of fruits per peduncle apart from its taxonomic role may have arisen due to innate genetic differences leading to different levels of fruit-set by species. Thus, the normal diploid *A. precatorius* has a mean of 12±1.80 number of fruit per peduncle while *A. pulchellus*, which is a polyploid (Agbagwa and Okoli, 2005b) and *Abrus* sp. were observed to have 2 ± 1.00 and 3 ± 1.50 respectively. ANOVA results show that the number of seeds per fruits appears to reflect the variation due to fruit length. Capincin and Irabagon (1950) recognized the utility of number of seed per pod as a taxonomic character in computing yield indices in another leguminous genus *Vigna*. However, among the *Abrus* species studied, this character may not be used *sensu stricto* due to overlaps observed between *A. precatorius* and *A. pulchellus*. Observed differences in stamen and style lengths were confirmed to be significant at P £ 0.05 with *A. precatorius* closely related to *Abrus* sp. in these characters. Similarities and differences in floral characters provide good taxonomic guide in species delimitation (Davis and Heywood, 1973; Metcalfe and Chalk, 1979; Stace, 1980; Akpabio and Olorode, 1988; Agbagwa and Ndukwu, 2004)

Results obtained with fresh collections of *A. precatorius, A. pulchellus* and *Abrus* sp., are similar to those observed for the herbarium specimens of *A. precatorius, A. pulchellus* and *A. canescens*. However, several shortcomings associated with the use of herbarium materials were encountered in the process of studying the species. Of great importance is the lack of inadequate information on fruit and floral morphology of the species. Thus, good information on number of seeds per fruit, peduncle length, hilium length, stamen and style lengths and numbers were lacking. While the fresh specimens of *A. precatorius* and *A. pulchellus* recorded higher number of pairs of leaflet, higher length and width of leaflets, their herbarium representatives had low values in these characters. The variation in the number of pairs of leaflets between fresh and herbarium specimens does not mean the evolution of more leaflets by the recent specimens, but a problem associated with handling of the specimens in the different herbaria visited. It was observed during the herbarium studies that several leaflets of the specimens had been lost and dimensions of leaflets reduced from long periods of drying and storage. Where scars of lost leaflets were not identified, those were inadvertently omitted. This also applies to the number of fruits per penduncle. This aspect of the results highlights the usefulness of fresh samples in morphological and especially morphometric studies and shows the demerit of over dependence on herbarium information for taxonomic elucidation of species.

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