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Comparative foliar epidermal studies in *Andropogon gayanus* (Kunth) and *Andropogon tectorum* (Schum & Thonns) in Nigeria

ABAYOMI EZEKIEL FOLORUNSO & OJUOLAPE FUNMILOLA OLANIYAN

Department of Botany, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria, afolorun@oauife.edu.ng; +2348035068602

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Abstract: The foliar epidermal studies were carried out on *Andropogon gayanus* and *Andropogon tectorum* with the aim of determining the patterns of variation in their epidermal characteristics and assessing their value in species identification and classification. Adaptive and endemic characters that may be useful in the identification of the savanna species (*A. gayanus*) are long cells longer in length and width; short cells longer in length and width; micro hair longer in length and width; straight anticlinal wall. Typical characters of the genus are important in the identification and classification of the genus; these are cell wall largely thick and straight, stomata amphistomatic, papillae largely numerous and uniform in size.

Keywords: foliar, epidermal, *Andropogon gayanus*, *Andropogon tectorum*, microhair, macrohair.

Introduction

The genus *Andropogon* belongs to the grass family Poaceae which is a very large cosmopolitan family consisting of about 50 to 60 tribes, 660 genera 9000 species throughout the world (OLORODE 1984; HUTCHINSON & DALZIEL 1972). *Andropogon* is a genus of about 29 species almost confined to the tropical and warm temperate regions of the world frequently forming an important part of the savannah grasses in the tropics. It is composed of annual or perennial grasses

frequently with tall culms; leaf blades linear to lanceolate or ovate, spikelet usually in pairs, one of each pair sessile, the other pedicelled usually with 2 flowers with the lower floret barren or male and the upper bisexual or female (HUTCHINSON & DALZIEL 1972).

The economic importance of *Andropogon gayanus* includes its use to modify fire regimes in the savanna regions. It is very palatable when young and serves as basic materials for woven houses. *Andropogon gayanus* is a highly productive grass, which increases fuel loads, produces intense, late dry season fires which seriously damage native woody species. *Andropogon tectorum* is used as animal food. ADOKI (2006) reported that *Azospirillum* species of bacteria are associated with roots of *Andropogon tectorum* which help in fixing atmospheric nitrogen into the soil.

The grass family, Poaceae, is noted for it's wide diversity and complexity and so has posed many problems to the taxonomists using the traditional method based on gross morphology (SRIVASTAVA 1978). Before the later part of the 19th century, taxonomists were confined to the use of the feature of reproductive organs, as floral characters were considered to provide the most valuable indicators of taxonomic affinities (NWOKEOCHA 1996). Of all the non-reproductive organs, the leaf is the most widely used in plant taxonomy. (STACE 1965, 1984, STRIVASTAVA 1978) described the leaf epidermis as the second most important character after cytology for solving taxonomic problems.

Following the work of METCALFE & CHALK (1950), which today serve as standard references on plant anatomy, the use of vegetative anatomical characters in taxonomy became a routine procedure. Since then, the immense value of the leaf epidermis and vegetative anatomy in grass systematics has been demonstrated by many workers, among whom are STRIVASTAVA (1978); RENVOIZE (1982, 1987); OGUNDIPE & OLATUNJI (1989, 1991) and FOLORUNSO & OYETUNJI (2007). This work is a contribution to the use of foliar anatomy in taxonomy, specifically in establishing the taxonomic relationship and differences between the two species of *Andropogon*.

Material and methods

The epidermal preparation of the adaxial and abaxial surfaces of the leaf blade were made in ten accessions each of *Andropogon tectorum* (collected along Ilesa-Akure Road) and *Andropogon gayanus* that was collected along Yankari National Park in Bauchi (Fig. 1). Voucher specimens are deposited in the Herbarium of the Department of Botany, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria. The leaves of the two plant were boiled in water for five-minutes to soften them. The scraping method (CUTLER 1978) was used for *Andropogon tectorum* and *Andropogon gayanus*. The specimen were decolourized in about 5% sodium hypoclorite (domestic bleach) for 30-60 minutes. The cleared epidermal peels were preserved in 50% ethanol, stained in Alcian blue and counter stained in Toluidene blue to enhance contrast. To enhance the identification of cork and silica cells, some peels were stained in 1% Sudan IV solution. All the preparations were mounted in 25% glycerol. Both

adaxial and abaxial surfaces of the leaves were studied. Illustrations of the foliar epidermal features were done by camera lucida under x 25 objective power of leitz DIALUX research microscope. Anatomical measurements were made in ocular units at x 40 objective powers and converted to micrometers. The stomata index (I) was estimated for the leaf surfaces using the formula:

$$\text{Stomata index (I)} = \left(\frac{S}{E+S}\right) X\ 100$$

S.I= Stomata Index
S= Number of Stomata per unit area
E= Number of Ordinary Epidermal cells plus subsidiary cells in the same unit area

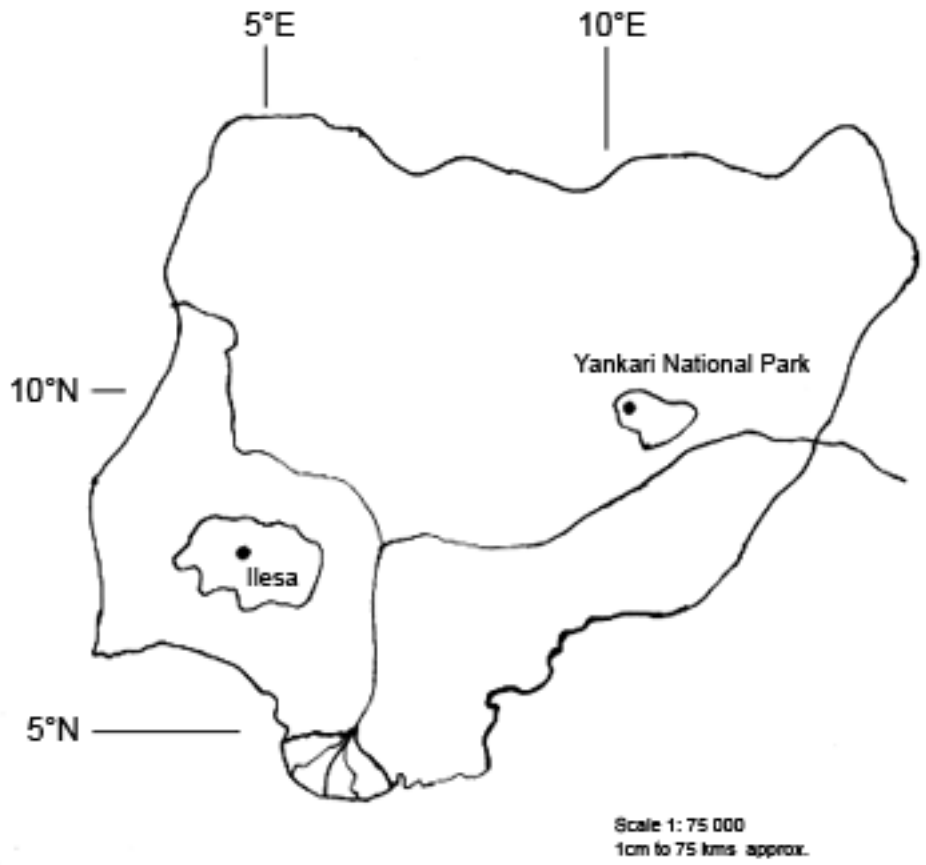

Fig. 1. Areas of collection of *Andropogon* species used for the study in Nigeria

Results

***Andropogon gayanus* (adaxial)** (Fig. 2a and Tab. 1)

Long Cells: rectangular, conspicuously elongated (many times longer than broad) 8-9 rowed between the vein, cell wall is thick and straight, papillae present, numerous and uniform in size.
Short Cells: numerous, solitary and present is rows of 2-3 cells.
Prickle hairs: none seen
Micro hairs : present and sometimes found on the short cells.
Macro hairs: none seen.
Stomata: paracytic stomata type present, large, numerous, 2-3 rows per band and dome-shaped
Anticlinal walls: straight.

***Andropogon gayanus* (abaxial)** (Fig. 2b and Tab. 1)

Long Cells: rectangular, slightly elongated, 4-5 rowed between the veins, cell wall is thick and straight, papillae present, numerous, small and of uniform sizes, present in between the stomata
Short cells: numerous, solitary and of equal sizes in rows of 2-3 cells.
Prickle hairs none seen
Micro hairs: present, longer on adaxial surface than on the abaxial surface.
Macro hairs: none seen
Stomata: paracytic stomata type present, numerous than on the adaxial surface, 5-6 rows per band and dome-shaped
Anticlinal walls: straight

***Andropogon tectorum* (adaxial)** (Fig. 3a and Tab. 2)

Long cells: rectangular, conspicuously elongated (many time longer than broad) 7-8 rowed between the veins, cell wall is thick and wavy, papillae present with uniform size.
Short cells: present over the veins in rows of 2 or more cells.
Prickle hairs: none seen
Micro hairs: present
Macro hairs: none seen
Stomata: large, infrequent stomata, paracytic stomata type present, dome-shaped, 2 banded between the veins.
Anticlinal walls: wavy

***Andropogon tectorum* (abaxial)** (Fig. 3b and Tab. 2)

Long cells: rectangular, conspicuously elongated (many times longer than broad): 2-3 rows between the veins, cell wall is thin and wavy, papillae present, more abundant than on the adaxial surface, small and of uniform size.
Short cells: infrequent , in continuous rows.
Prickle hairs: none seen

Micro hairs: none seen

Macro hairs: infrequent, long and slender with the apex sharply pointed; hair base large.

Stomata: numerous on the abaxial than on the adaxial surface, dome-shaped, paracytic stomata present, 3-4 banded between the veins.

Tab. 1. Some descriptive statistics of leaf epidermal attributes of *Andropogon gayanus* (number of measurements n=10)

Trait (µm)	Minimum		Maximum		Mean		Standard deviation		Standard error	
	Adaxial	Abaxial	Adaxial	Abaxial	Adaxial	Abaxial	Adaxial	Abaxial	Adaxial	Abaxial
Length of stomata	2.92	3.24	3.31	3.60	3.12	3.42	0.19	0.18	± 0.28	±0.25
Width of stomata	2.70	1.91	2.88	2.23	2.79	2.07	0.09	0.16	±0.18	±0.22
Length of long cells	10.08	3.96	13.32	7.92	11.70	5.94	1.62	1.98	±2.29	±2.80
Width of long cells	1.80	1.62	1.87	2.16	1.84	1.89	0.04	0.27	± 0.05	±0.38
Length of short cells	1.62	1.87	1.98	2.20	1.80	2.04	0.18	0.17	± 0.25	± 0.23
Width of short cells	1.76	1.12	1.84	1.44	1.80	1.28	0.04	0.16	±0.06	±0.23
Length of micro hairs	28.48	10.80	32.44	21.67	30.46	16.24	1.98	5.44	± 2.80	±7.69
Width of micro hairs	1.15	1.48	1.80	1.91	1.48	1.70	0.33	0.22	± 0.46	± 0.30

Tab. 2. Some descriptive statistics of leaf epidermal attributes of *Andropogon tectorum* (number of measurements n=10)

Trait (µm)	Minimum		Maximum		Mean		Standard deviation		Standard error	
	Adaxial	Abaxial	Adaxial	Abaxial	Adaxial	Abaxial	Adaxial	Abaxial	Adaxial	Abaxial
Length of stomata	3.27	3.28	3.28	3.92	3.28	3.60	0.005	0.32	± 0.007	±0.45
Width of stomata	2.20	2.16	2.23	2.48	2.22	2.32	0.015	0.16	±0.02	±0.22
Length of long cells	7.56	4.50	8.28	5.51	7.92	5.01	0.34	0.50	±0.47	±0.71
Width of long cells	1.76	2.27	1.91	2.59	1.84	2.43	0.08	0.16	± 0.11	±0.23
Length of short cells	1.12	1.44	1.55	1.80	1.34	1.62	0.22	0.18	±0.30	±0.05
Width of short cells	0.72	1.12	0.79	1.76	0.76	1.44	0.04	0.34	±0.05	±0.47
Length of micro hairs	12.6		30.6		21.6		9.00		±12.72	
Width of micro hairs	3.96		4.32		4.14		0.18		± 0.25	
Length of macro hairs		14.04		15.12		14.58		0.54		±0.76
Width of micro hairs		1.87		1.08		1.48		0.40		±0.56

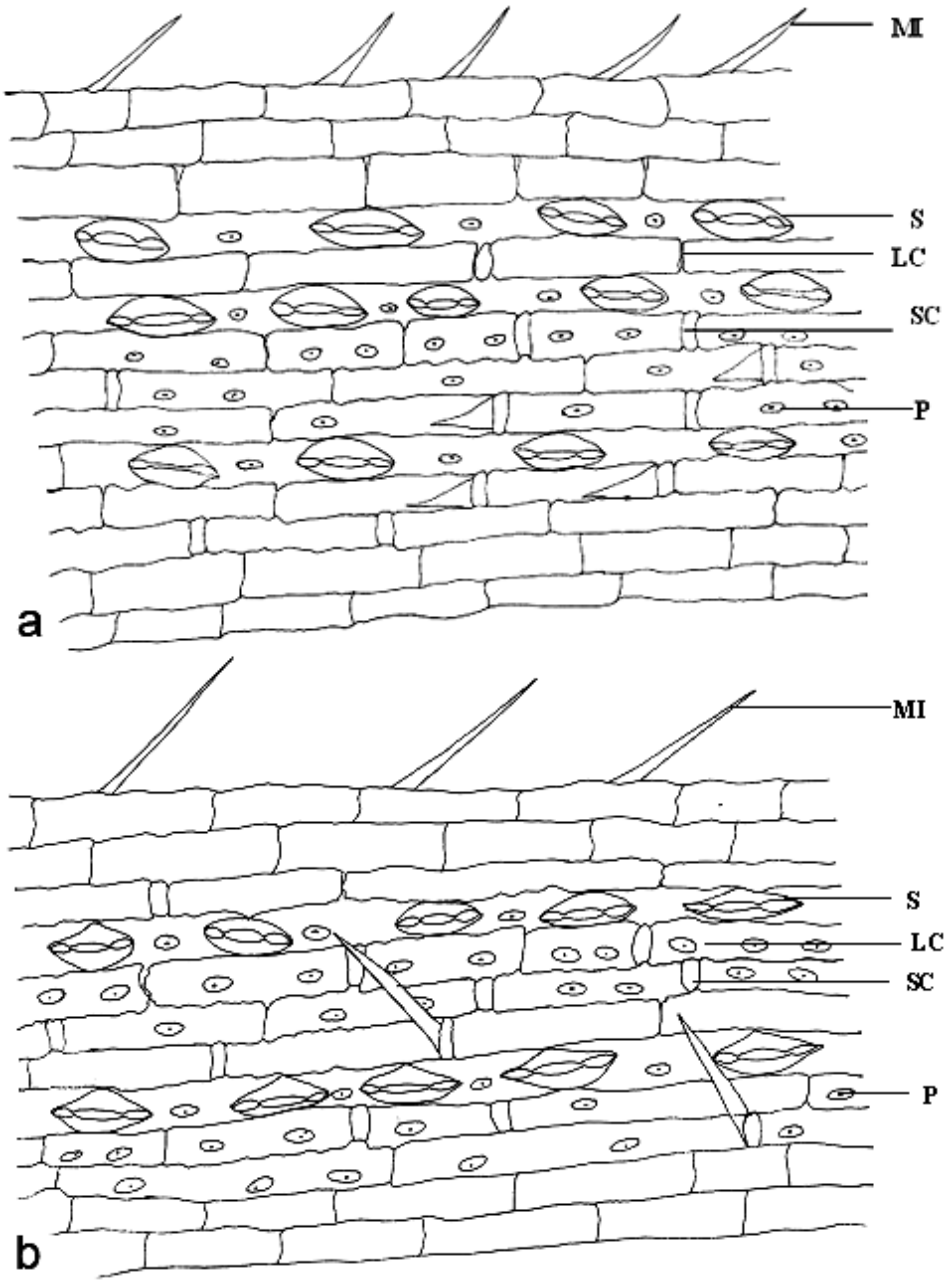

Fig. 2. The leaf epidermal features of *Andropogon gayanus* (a - adaxial epidermis, b – abaxial epidermis); MI – microhairs, S – stomata, LC - long cells, SC - short cells, P - papillae

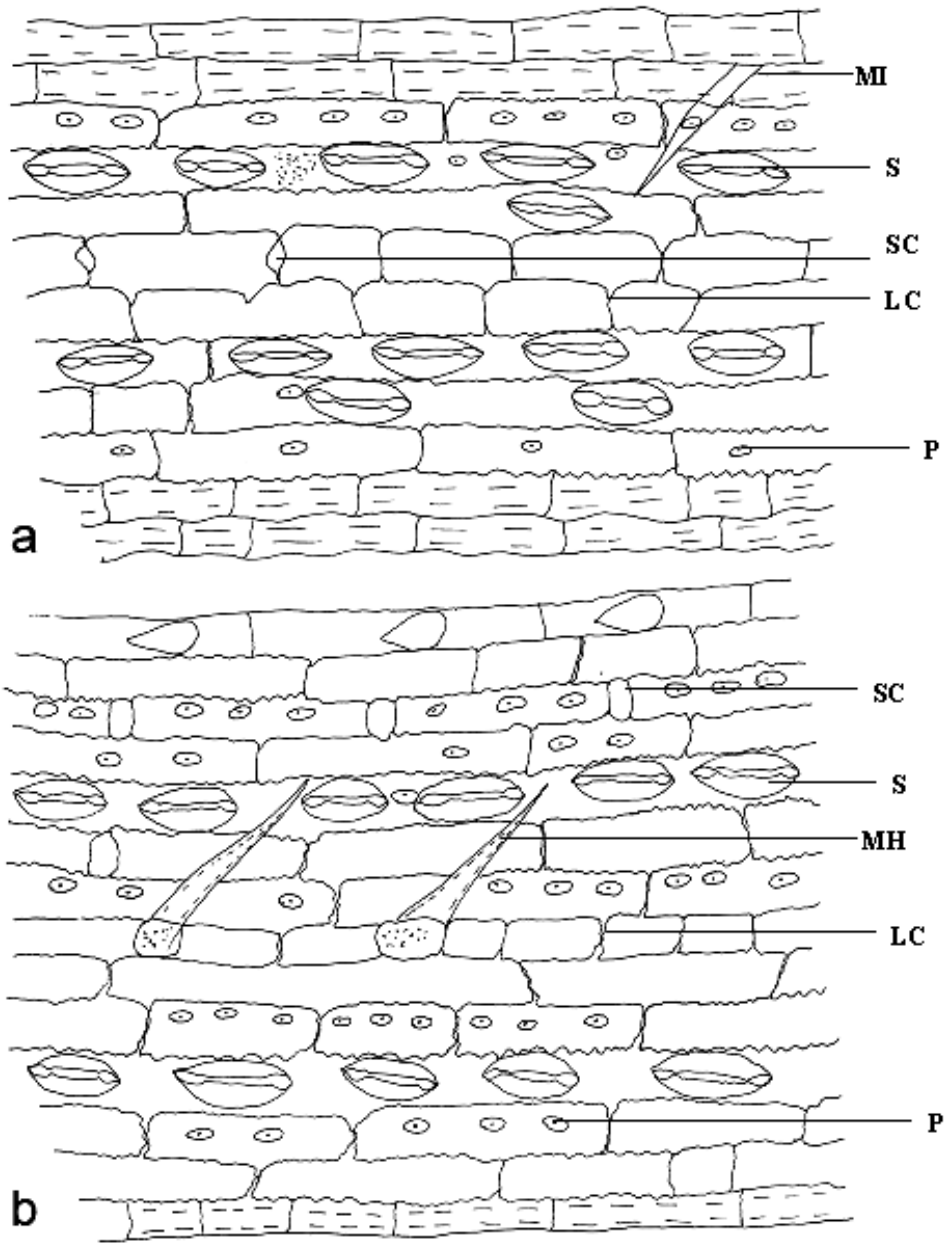

Fig. 3. The leaf epidermal features of *Andropogon tectorum* (a - adaxial epidermis, b – abaxial epidermis); MI – microhairs, S – stomata, LC - long cells, SC - short cells, P - papillae

Discussion

CARQUIST (1961) as reported by ILLOH (1995) stated that the leaf provides variety of anatomical features that can be of taxonomic utility. Results of the study revealed that there are many anatomical variations between the 2 species of *Andropogon* studied. However, some of the characters were present in all of them and may be typical of the genus or family.

METCALFE (1954) pointed out that certain character of the epidemic such as shape of the subsidiary cells of the stomata, micro hairs and silica cells are important systematically. Of all the epidermal characters studied, the length and width of long cells, the length and width of short cells, the length and width of Micro hair and anticlinal wall showed significant difference between the two species of *Andropogon*. The long cells and short cells in terms of length and width are longer in *A. gayanus* than in *A. tectorum*. Similarly, micro hair in terms of length and width is longer in *A. gayanus* than in *A. tectorum*. All these features which are more conspicuous in *A. gayanus* combined with its straight anticlinal wall may be adaptive and endemic in the savanna species.

Characters typical of the genus are cell wall largely thick and straight, amphistomatic stomata type, papillae largely numerous and uniform in size. All these characters are of taxonomic importance in the identification and classification of the genus. In conclusion, adaptive and endemic characters in the savanna species (*A. gayanus*) had been reported along with the taxonomic characters of the genus.

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