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FOLIAR EPIDERMAL STUDIES OF THIRTY-FIVE ACCESSIONS OF *PANICUM MAXIMUM* JACQ. IN NIGERIA

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The foliar epidermis of 35 accessions of *Panicum maximum* Jacq. were studied. The results show that all the accessions are amphistomatic possessing paracytic type of stomata on both the adaxial and abaxial epidermal surfaces. The subsidiary cells are predominantly triangular in shape but often low-dome too. The intercostal, short cells are mostly solitary but occasionally paired, often associated with silica containing cells. Prickle hair are generally absent on the costal zone of the abaxial surface but present on the costal zone of the adaxial surface and intercostal zones of both surfaces at different frequencies. The microhair also occur at different frequencies. Accession 35 collected from a transition zone marking the southern end of major distribution of *P. maximum* is unique in having the biggest stomatal size and 3 - 4 stomata bands on the intercostal zone. The implication of this as related to the ecologies of the Sahel, Guinea and Sudan Savanna Zones of Nigeria is discussed.

Key words : Foliar epidemis, *Panicum maximum*, Nigeria

INTRODUCTION

Panicum maximum Jacq. which originates from East Africa (Bogdan, 1977, Boonman, 1993) is a valuable grass for grazing, hay and silage. It is reputed to

be very palatable to all kinds of stock, at least at reasonably early stages of growth usually a few days to a few weeks after the last cut or grazing (Lazo *et al.*, 1997 Santos *et al.*, 1999).

Leaf anatomical characters have been used successfully in classification in the Gramineae (Poaceae), (Prat, 1960; Srivastava, 1978; Renvoize, 1987; Palmer and Gerbeth Jones, 1986). Ogundipe and Olatunji (1991) also used the vegetative anatomy to determine the taxonomic position of the species of *Brachiaria*. Avdulov (1931) and Prat (1960) emphasized the vital role of foliar epidermal studies in their various reports. Metcalfe (1960) in the stomata of matured grasses reported four types of subsidiary cells, parallel sided, low-dome, triangular and high-dome. *Panicum maximum* is a very important herbage for animals in Nigeria, most especially in Southwestern Nigeria and there is no report on its foliar epidermal features. This work is planned to redress this knowledge gap.

MATERIALS AND METHODS

Living plant materials were collected from wild populations in the geographical Southwestern part of Nigeria. This falls within the lowland rainforest and derived savanna ecological zone comprising Osoo, Oyo, Ogun, Ondo and Kwara States. These were planted in the Botanical Garden in Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria. The accessions were brought into cultivation by transplanting root-stocks of the accessions from the wild in the experimental plot. Thirty-five accessions were studied. Table 1 shows the sources, locations, distinguishing characters and collectors of the accessions.

Epidermal preparations of the abaxial and adaxial surfaces of the leafblade were made from 5 specimens of each accession by placing a portion from the median section of a matured leaf on a glass slide and scraping off carefully with a sharp razor blade the tissues above the desired epidermis. Loose cells/tissue scraped off were washed away (Cutler, 1978). The specimens were decolourised in about 5% solution 5% sodium hypochlorite (domestic bleach) for 30 - 60 minutes. The cleared epidermal peels were preserved in 50% ethanol, stained in Alcian blue and counter-stained in Toluidine" blue to enhance contrast. The peel was mounted on a clean slide in 25% glycerol. To enhance the identification of cork and silica cells, some epidermal peels were stained in 1 % Sudan IV solution and mounted in 25% glycerol.

Table 1:

Accessions of *Panicum maximum* Jacq. Studied and their sources.

Accession number	Location	Description	Collector
1 - 2	Directly behind Faculty of Agriculture Obafemi Awolowo University campus, Ile-Ife. 7°30"N 4°31"E, Nigeria	Broad leaves, heavy tillering, culm diameter fairly big. Plant type generally robust.	Adedeji & Faluyi
3	Ruderal behind Faculty of Agriculture, on the way to quarters, O.A.U, Ile-Ife. 7°30"N 4°31"E, Nigeria.	Narrow leaves, intermediate tillering, culm diameter thin. Plant type not so robust.	
4 - 6	Inside the bush on Road 18, O.A.U. Staff quarters, Ile-Ife 7°30"N 4°31"E, Nigeria.	Mostly, broad-leaved, heavy tillering, culm diameter fairly big. Plant type robust	
7-9	Ruderal on Road 18, O.A.U., Staff quarters, Ile-Ife. 7°30"N 4°31"E, Nigeria.	Narrow leaves, heavy tillering, culm diameter small. Plant type not robust.	
10	Inside the bush on Road 8, O.A.U. Staff quarters, Ile-Ife 7°30"N 4°31"E, Nigeria.	Broad leaves, heavy tillering, culm diameter big. Plant robust.	
11	Inside Odeda quarters, Abeokuta, Ogun State. 7°10"N 21"E, Nigeria.	Broad leaves, heavy tillering, culm diameter big. Plant robust.	Faluyi & Nwokeocha
12	Ruderal, Abeokuta - Ibadan Road 7°15"N 3°25"E, Nigeria.	Narrow leaves, heavy tillering, culm diameter small. Plant type robust	
13	Abeokuta - Ibadan road, inside the bush 7°15"N 3°25"E, Nigeria.	Narrow leaves, heavy tillering, culm diameter small. Plant robust.	
14 - 15	Ruderal, Abeokuta - Ibadan road, 7°15"N 3°25"E, Nigeria.	Narrow leaves, low tillering, culm diameter small. Plant not robust.	
16	National Cereals Research Institute (N.C.R.I.), Apata, Ibadan, Oyo State 7°17"N 3°30"E, Nigeria.	Broad leaves, heavy tillering, culm diameter big. Plant robust	

Table 1: Continued

Accession number	Location	Description	Collector
17	Inside the bush, Apata, Ibadan, Oyo State 7°17'N 3°30'E, Nigeria.	Broad leaves, heavy tillering, culm diameter big. Plant robust	"
18	Ruderal, Apata, Ibadan, Oyo State. 7°17'N 3°30'E, Nigeria.	Narrow leaves, low tillering, culm diameter small. Plant type not robust.	Faluyi & Nwokeocha
19 - 22	Teaching and Research farm O.A.U. Ile-Ife. 7°30'N 4°31'E, Nigeria.	Broad leaves, heavy tillering, culm diameter big. Plant robust.	Adedeji & Faluyi
23 - 24	Ruderal, Federal University of Technology, Akure (F.U.T.A) School area, Ondo State 7°15'N 5°14'E, Nigeria	Narrow leaves, low tillering, culm diameter small. Plant not robust.	Adedeji
25	F.U.T.A. Staff quarters, Akure, Ondo State. 7°15'N 5°14'E, Nigeria	Broad leaves, heavy tillering, culm diameter big. Plant robust	"
26	Ruderal in front of a house, F.U.T.A. Staff quarters, Akure, Ondo State 7°15'N 5°14'E, Nigeria.	Narrow leaves heavy tillering culm diameter small. Plant not so robust	"
27 - 28	Abandoned farmland, F.U.T., Akure, Ondo State 7°15'N 5°14'E, Nigeria.	Broad leaves, heavy tillering, culm diameter big. Plant robust.	Adedeji
29	Ruderal, F.U.T., Akure, Ondo State 7°15'N 5°14'E, Nigeria.	Narrow leaves, low tillering, culm diameter small. Plant type not robust.	"
30 - 33	Oil palm plantation Apoje, Ijebu-Igbo, Ogun State, in the open 6°58'N 4°00'E, Nigeria.	Broad leaves, heavy tillering, culm diameter big. Plant robust	Adedeji & Faluyi
34	Oil palm plantation Apoje, Ijebu-Igbo, Ogun State, in the shade 6°58'N 4°00'E, Nigeria.	Narrow leaves, intermediate tillering, culm diameter small. Plant not so robust.	"
35	Ruderal, Ilorin-Offa road on the Kwara State - Osun State boundary 8°32'N 4°34'E, Nigeria.	Narrow leaves, low tillering, culm diameter small. Plant not robust	Faluyi

RESULTS

Costal Zone: (Adaxial and Abaxial epidermides, Figs. 1-8, Table 2, Plate 1).

Long cells: rectangular, many times longer than broad with width more or less uniform; anticlinal cell wall sinuous; end walls mostly perpendicular, occasionally oblique.

Short cells: abundant, in continuous rows along veins; mostly 1 row per costal region but occasionally up to 4 or 6 rows for big costal regions; silicabodies appear singly, in pairs or in groups of 3 - 10 cells; on the adaxial epidermis; silica bodies are mostly dumb-bell to nodular shaped in all the accessions studied, nodular to cross shaped in accessions 1, 2, 7 and 8, generally dumb-bell to nodular shaped on the abaxial epidermis; cork cells common, alternate with silica cells.

Prickle hair:

Present only on the adaxial epidermis, absent on the abaxial. On the adaxial surface very sparse to sparse in accessions 3, 12, 13, 16, 18, 28 and 32, fairly frequent to abundant in all other accessions; base large, raised, apex sharply pointed

Microhair: None seen.

Stomata: None seen.

Intercostal Zone

(a) Adaxial epidermis (Figs. 1 - 4, Table 2, Plates 1B, C and D)

Long cells:

Rectangular; many times longer than broad, breadth more or less uniform, cell wall prominently sinuous; in most cases cells at the furrow are distinctly broader and appear shorter than long cells just after the costal region with shapes ranging from rectangular to polygonal to cubical in all the accessions with the cell wall straight to slightly sinuate or undulate; end walls perpendicular occasionally oblique

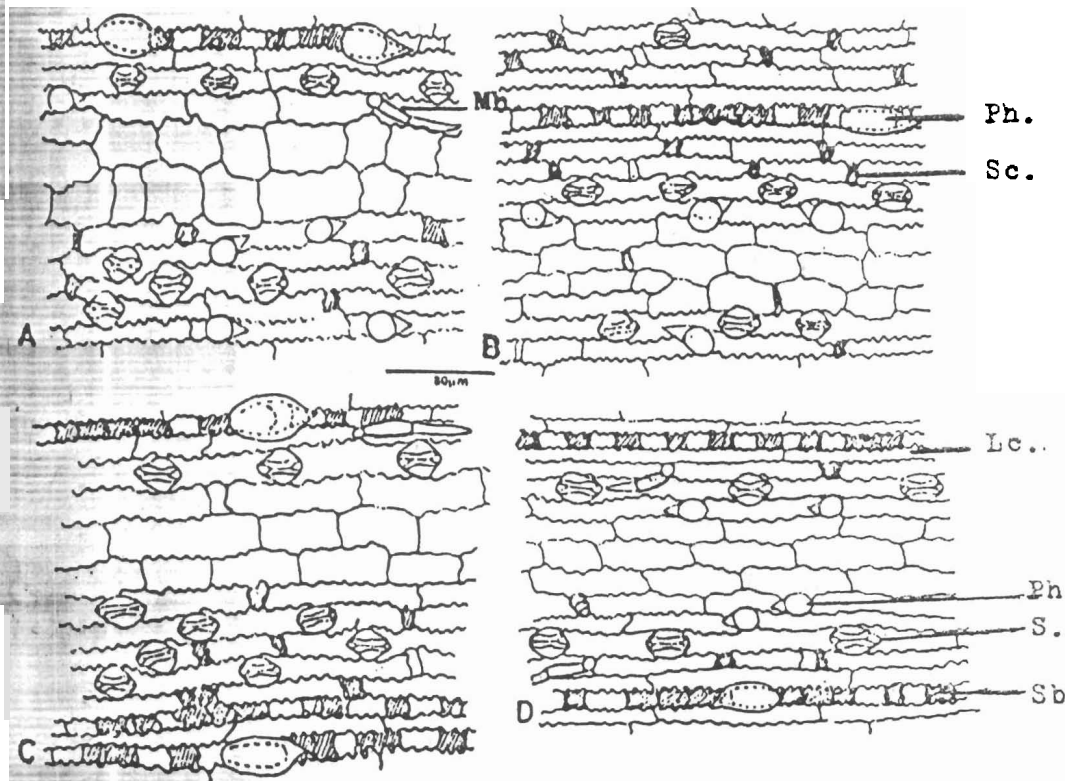


Fig. 1: The adaxial leaf epidermal features, of *P. maximum*

- A. Adaxial epidermis of accession 1
- B. Adaxial epidermis of accession 2
- C. Adaxial epidermis of accession 4
- D. Adaxial epidermis of accession 5

Ph. Prickle hair; Sb. Silica body; Lc. Long cell; Sc. Short cell; mho microhair; S stomata

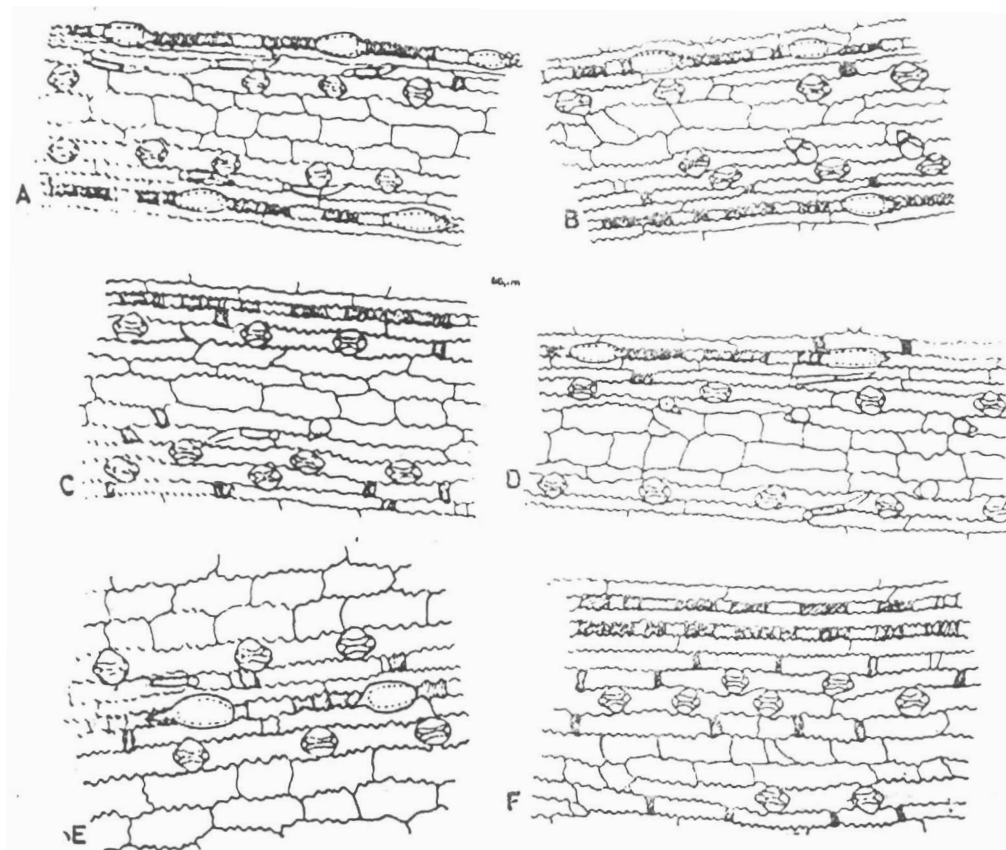


Fig. 2: The adaxial leaf epidermal features of *P. maximum*

- A. Adaxial epidermis of accession 6
- B. Adaxial epidermis of accession 7
- C. Adaxial epidermis of accession 8
- D. Adaxial epidermis of accession 9
- E. Adaxial epidermis of accession 11
- F. Adaxial epidermis of accession 13

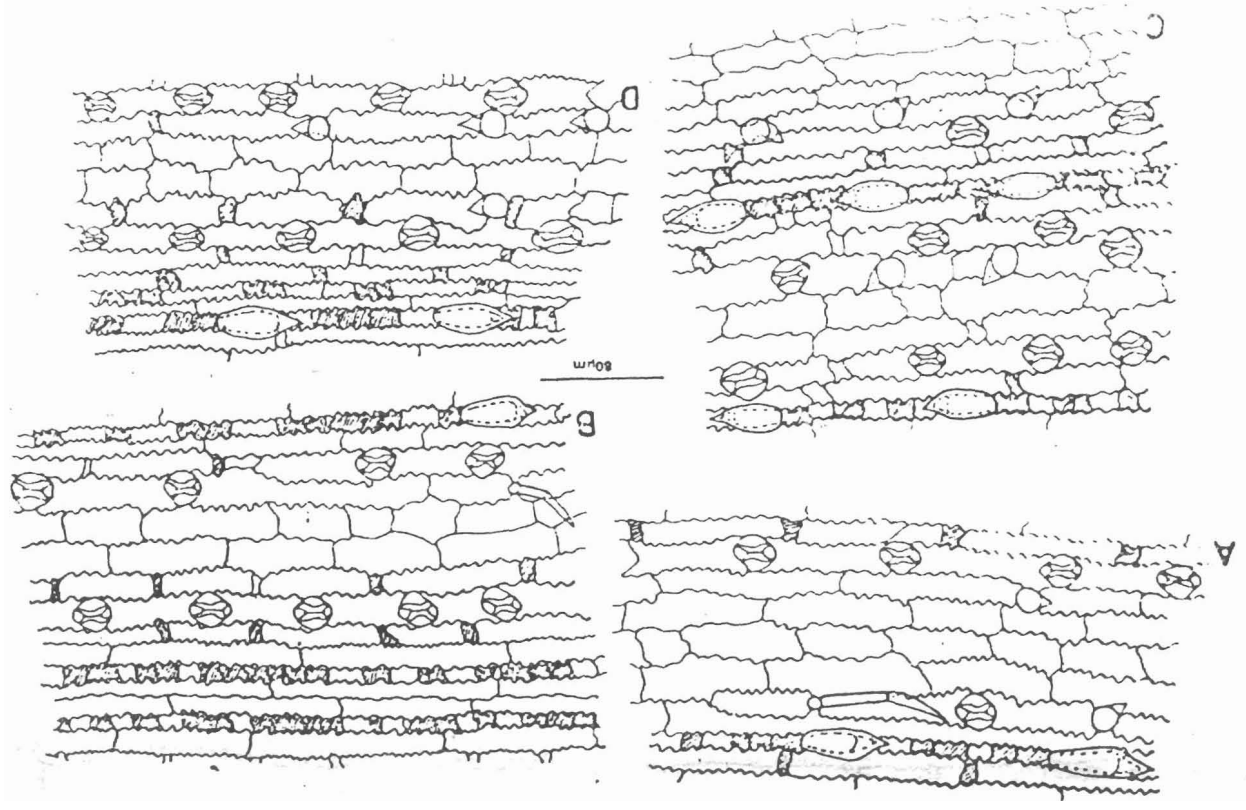


Fig. 3. The adaxial leaf epidermal features of *H. maximum*.
 A. Adaxial epidermis of accession 16
 B. Adaxial epidermis of accession 18
 C. Adaxial epidermis of accession 22
 D. Adaxial epidermis of accession 32

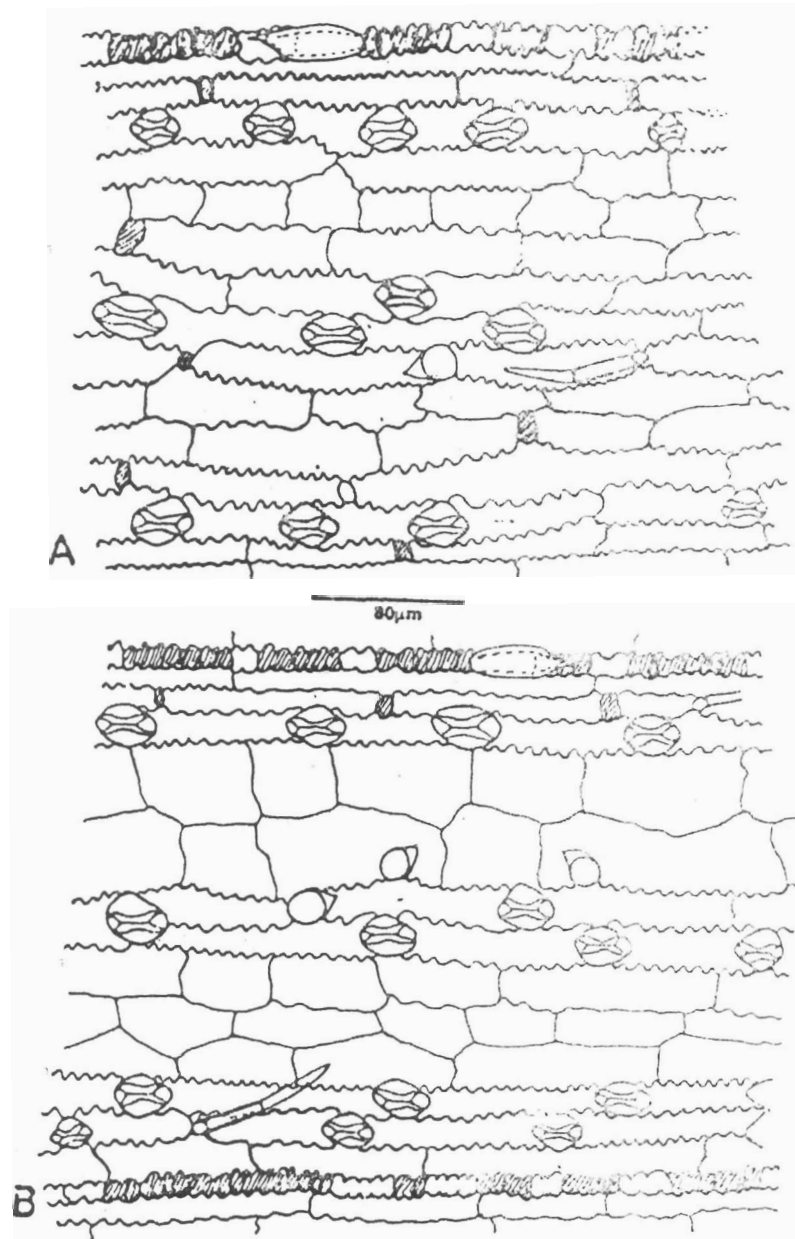


Fig 4: The adaxial leaf epidermal features of *P. mact*

A. Adaxial epidermis of accession 34

B. Adaxial epidermis of accession 35

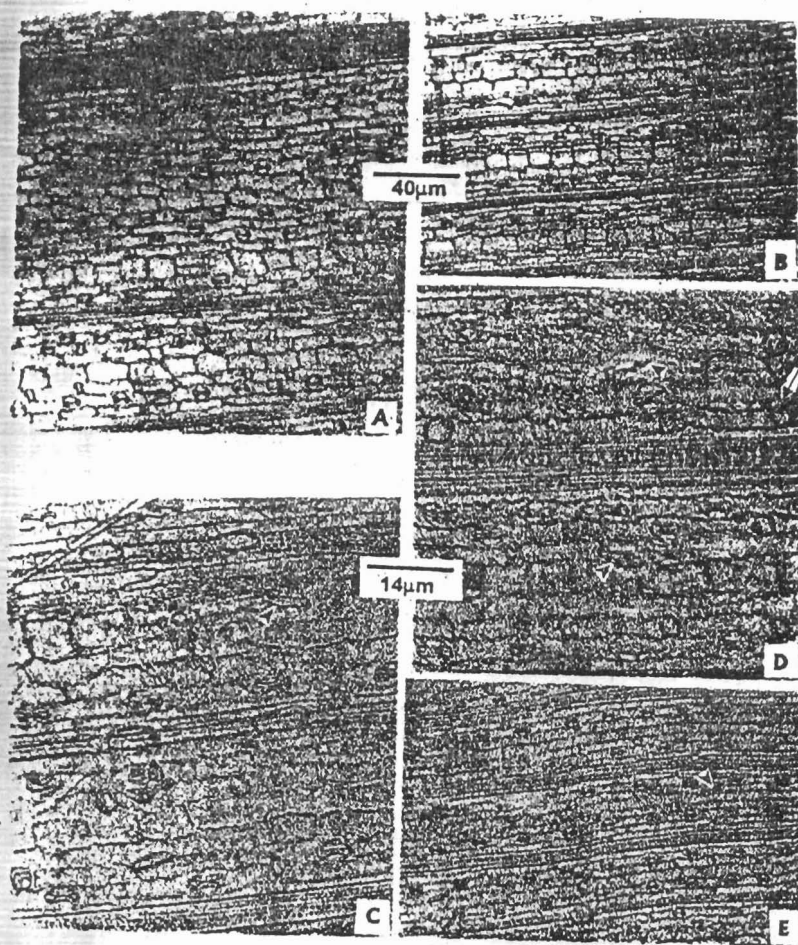


Plate 1: Salient foliar epidermal features in *Panicum maximum*.

- A. Abaxial surface of accession 35, showing an intercostal region with 4 bands of stomata, 1-2 rows per band.
- B. Adaxial surface of accession 33, showing costal prickles with 3 intercostal zones
- C. Adaxial surface of accession 9, showing costal prickles with 2 intercostal zones. (Arrow head shows microhair).
- D. Adaxial surface of accession 8 showing 2 intercostal zones; intercostal prickles and microhair; (full arrow shows intercostal prickle).
- E. Abaxial surface of accession 11, showing 4 costal zones and 3 intercostal zones (Arrow head shows microhair).

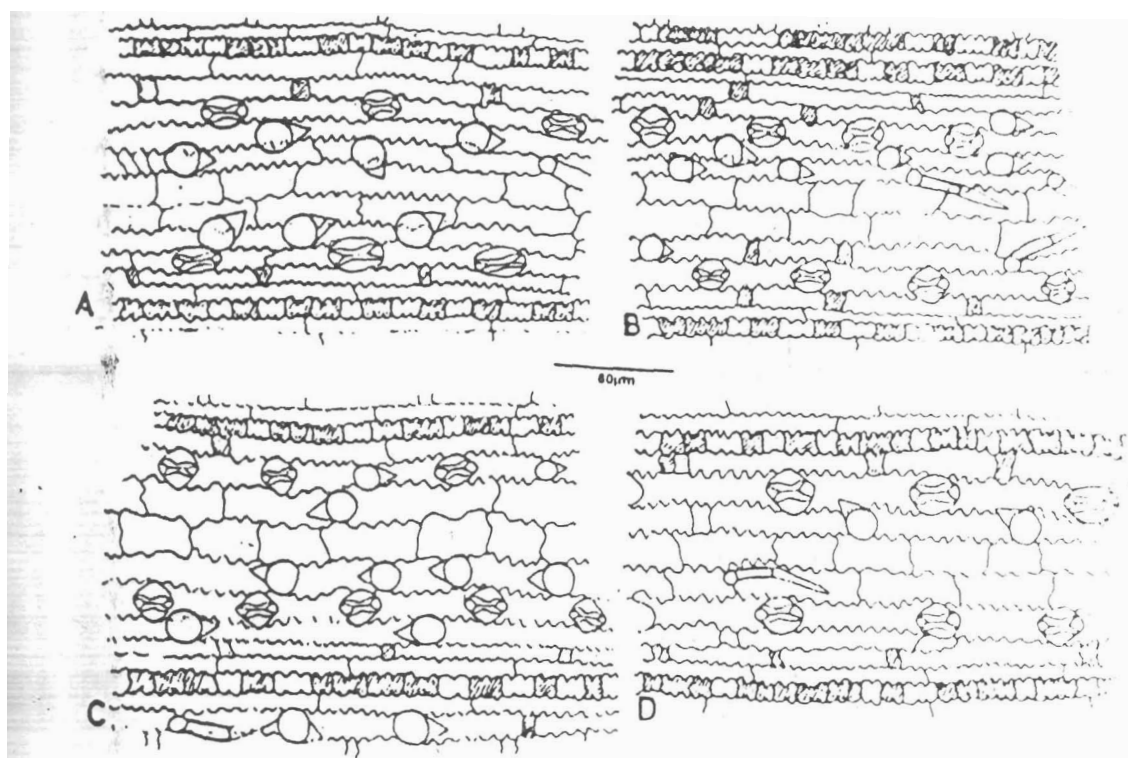


Fig. 5: The abaxial leaf epidermal features of *P. maximum*

- A. Abaxial epidermis of accession 1
- B. Abaxial epidermis of accession 2
- C. Abaxial epidermis of accession 4

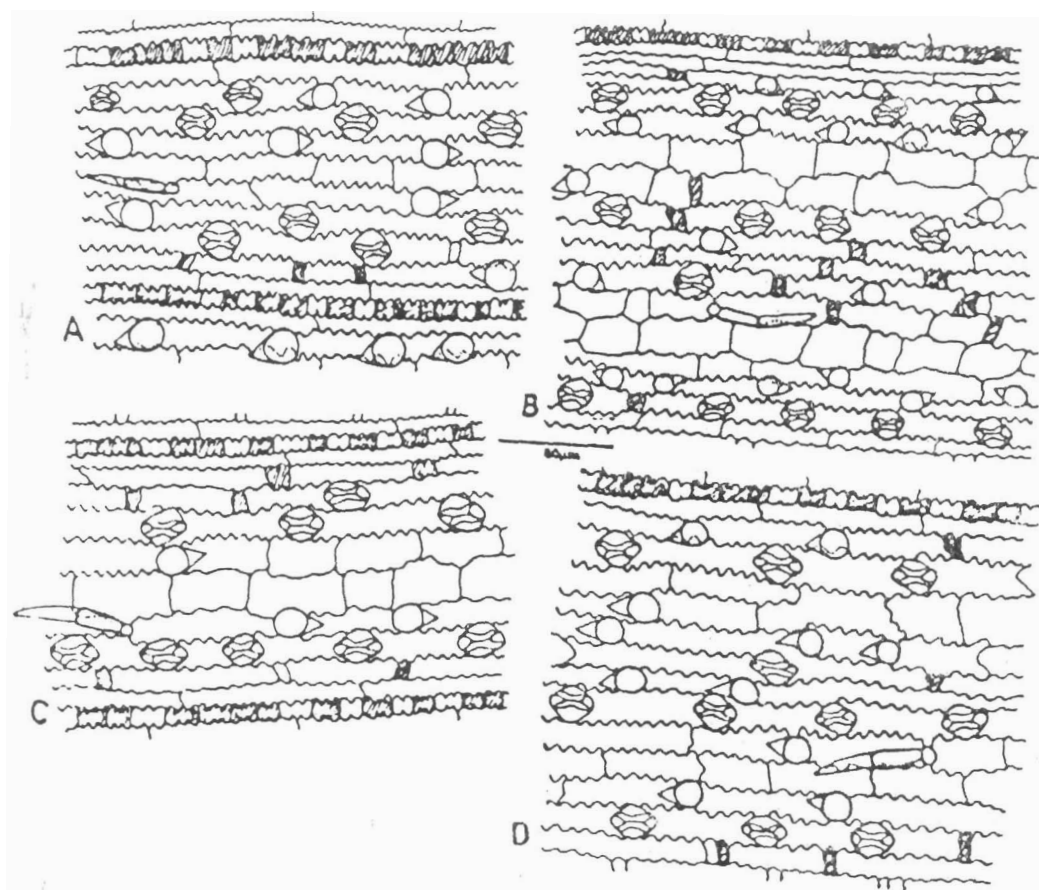


Fig. 6: The abaxial leaf epidermal features of *P. maximum*

- A. Abaxial epidermis of accession 6
- B. Abaxial epidermis of accession 7
- C. Abaxial epidermis of accession 8
- D. Abaxial epidermis of accession 9

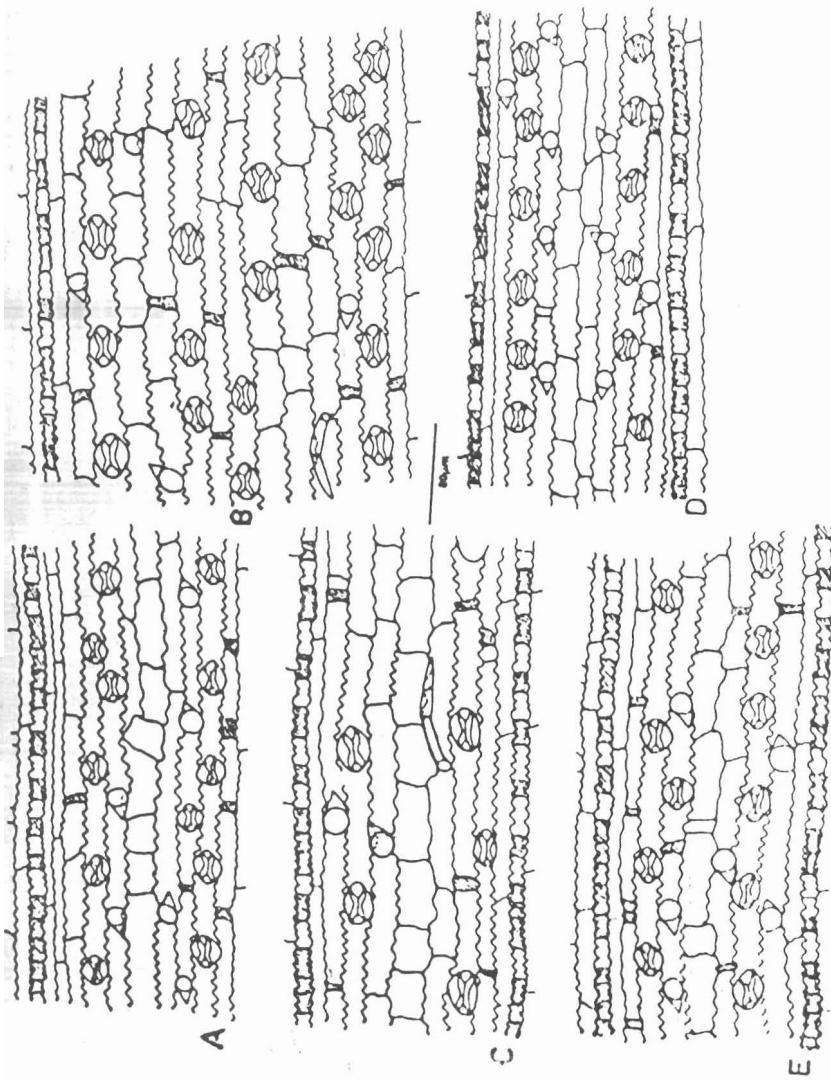


Fig. 7: The abaxial leaf epidermal features of *P. matsumii*

- A. Abaxial epidermis of accession 11
- B. Abaxial epidermis of accession 13
- C. Abaxial epidermis of accession 16
- D. Abaxial epidermis of accession 18
- E. Abaxial epidermis of accession 24

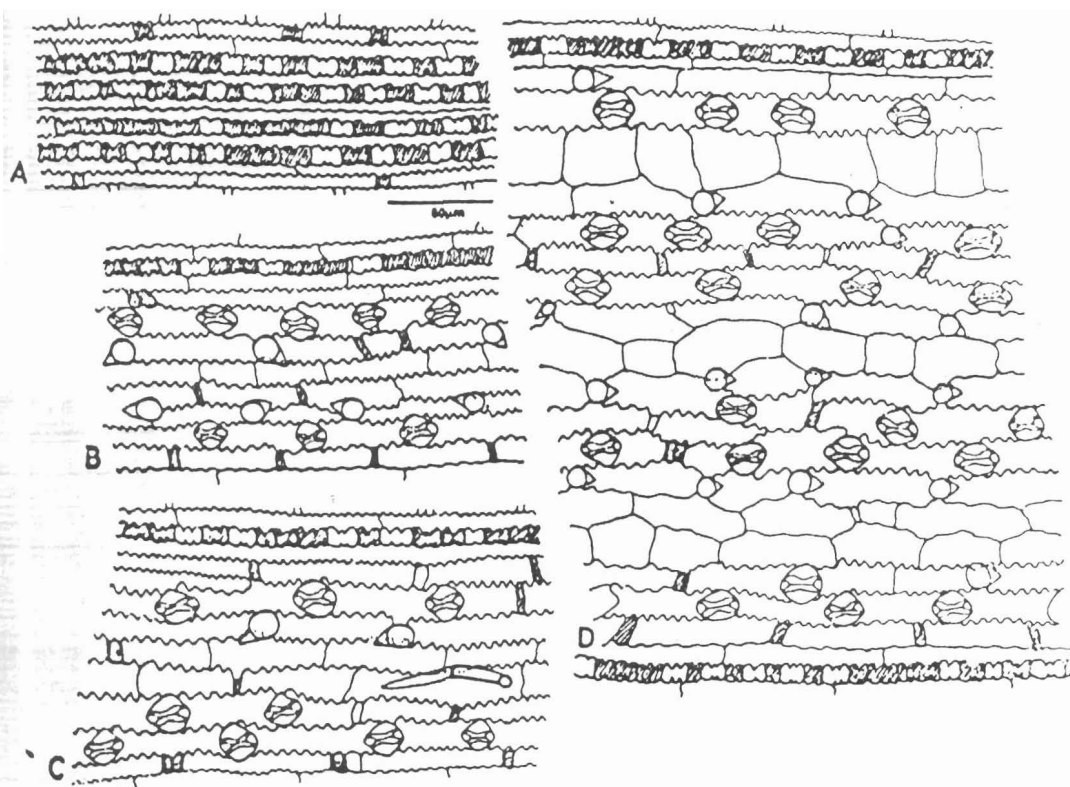


Fig. 8 : The abaxial leaf epidermal features of *P. maximum*

A Abaxial epidermis (costal zone only) of accession 34

B. Abaxial epidermis of accession 32

C. Abaxial epidermis of accession 34

D. Abaxial epidermis of accession 35

Short cells:

Frequent in all the accessions studied; mostly solitary but occasionally paired; mostly occurring just after the costal region or in between the interstomatal cells; often filled with silica; cork cells occur but rare; silica bodies take the shape of silica cells.

Stomata:

Abundant; paracytic; subsidiary cells triangular to low-dome in accessions 1,2,3,4,5,6,7,8,9,10,11,13, 14, 15, 16, 17, 18, 19,22,26, 27, 31 and 35; Low-dome to occasionally triangular in the rest of the accessions; mostly 2 bands of stomata per intercostal zone, occasionally 3, most especially after a big costal zone: 1 - 3 rows per band, but only 1 - 2 rows were found in accessions 1, 2, 18 and 22; Accession 35 is unique in having 3 - 4 stomata bands occurring more frequently than in any other accession (Fig. 4B, Plate 1A) and occurs even after a small Costal zone of just 1 row of silica cells unlike in other accessions where if 3 bands will occur at all, it will be after a big costal zone of not less than 3 - 4 rows of silica cells, it also has the highest stomata size (Table 2): mostly 1 row per band, but occasionally 2 - 3.

Interstomatal cells:

Mostly rectangular; 2 - 6 times longer than broad; width more or less uniform; transverse end walls concave; anticlinal cell wall sinuous.

Prickle hair:

Very sparse in accessions 2, 13, 14, 15, 17, 18; sparse in accessions 6, 8, 10, 12, 16, 32 and 33; sparse to frequent in accessions 9, 19, 26 and 34; frequent in all other accessions studied; hook-like; base small; raised; apex sharply pointed; occurring sparsely or in rows between the long cells just after the costal region, in between long cells just before the cells at the furrow and occasionally inbetween interstomatal cells.

Microhair:

Sparse in accessions 2, 3, 4, 5, 6, 9, 19, 20, 21, 22, 23, 24 and 28; sparse to frequent in accessions 11, 12, 16, 17, 18, 26, 30, 32, 34 and 35; frequent in all other accessions studied; bicellular; apical cell shorter than basal cell in accessions 3, 6, and 12, often shorter than basal cell but occasionally longer in accessions 2 and 4, shorter than basal cell or approximately of equal length as basal cells in accessions 5, 7, 9 and 31, slightly longer than basal cell but

occasionally approximately of equal length in accessions 13, 15, 16 and apical cell slightly longer than basal cell in all other accessions (Table 2); apex sharp to blunt; taper up; basal cell walls thicker than apical cell walls.

(b) Abaxial epidermis (Figs. 5 - 8; Plate 1A and E).

Long cells:

Rectangular; many times longer than broad; width more or less uniform; cell wall markedly sinuous; end walls mostly perpendicular, occasionally oblique.

Short cells:

Frequent in all the accessions studied: often solitary, occasionally paired; often filled with silica; cork cell rare; silica bodies take the shape of the silica cells.

Stomata:

Abundant; paracytic; subsidiary cells triangular to low-dome in accessions 1, 2, 3, 6, 8, 11, 13, 14, 16, 17, 18, 19, 20, 21, 22, 25, 28, 33 and 35; low-dome in accessions 10, 12 and 24, mostly triangular but very occasionally low-dome in the rest of the accessions; mostly 2 bands of stomata per intercostal zone, occasionally 3 most especially after a big costal zone; 1 - 3 rows per band but only 1 - 2 rows were observed in accessions 1 and 18. Accession 35 is unique in having 2 - 4 stomatal bands per intercostal zone occurring normally even after a small costal zone (Fig. 8D, Plate 1 A). It is the only accession so far where 4 stomatal bands are seen. 4 rows of stomata per band was not observed in any other accession. It also has the highest stomata size (Table 2).

Interstomatal cells:

Rectangular; 2 - 6 times longer than broad; width more or less uniform; transverse end walls concave; anticlinal cell wall sinuous.

Prickle hair:

Sparse in accessions 15, 17, 18, and 33 but frequent in all other accessions; hook-like; base small, raised; apex sharply pointed; occurring sparsely or in rows between the long cells just before the cells at the furrow and occasionally inbetween

Table 2. Foliar Epidermal Features of the Accessions of *P. maximum*

Acc No	Stomata Size (m)				Long Cell Size (m)				Lengths of Microhair (m)						Total Length (m)		Basal/Apical	
	Adaxial		Abaxial		Adaxial		Abaxial		Adaxial			Abaxial			Adaxial	Abaxial	Adaxial	Abaxial
	L	B	L	B	L	B	L	B	Basal cell	Apical cell	Max. breadth	Basal cell	Apical cell	Max. breadth				
1	35.43 ±0.20	23.65 ±0.15	33.37 ±0.41	24.05 ±0.40	90.00 ±3.32	20.24 ±0.51	99.5 ±4.50	18.30 ±0.37	44.50 ±0.30	41.19 ±0.50	9.15 ±0.10	38.10 ±0.20	38.80 ±0.52	8.84 ±0.11	85.69 ±1.66	76.90 ±0.35	1.080	0.982
2	36.63 ±0.10	24.05 ±0.22	34.41 ±0.30	25.16 ±0.30	88.06 ±3.84	25.53 ±0.60	118.4 ±4.47	19.24 ±0.34	43.66 ±0.20	40.18 ±0.45	9.25 ±0.14	37.00 ±0.16	36.63 ±0.43	8.51 ±0.12	83.84 ±1.74	73.63 ±0.19	1.087	1.010
3	34.04 ±0.12	24.42 ±0.19	31.08 ±0.19	22.20 ±0.22	92.20 ±2.57	17.39 ±0.12	97.31 ±2.56	16.65 ±0.16	46.40 ±0.20	40.48 ±0.31	9.32 ±0.08	46.99 ±0.25	49.21 ±0.54	9.47 ±0.06	86.88 ±2.96	96.20 ±1.11	1.146	0.955
4	29.60 ±0.00	22.94 ±0.25	28.12 ±0.19	25.90 ±0.22	74.74 ±0.58	15.54 ±0.25	91.39 ±1.37	16.95 ±0.06	41.44 ±0.37	39.44 ±0.64	7.25 ±0.04	34.04 ±0.66	35.15 ±0.94	9.47 ±0.12	80.88 ±1.00	69.19 ±0.56	1.051	0.968
5	30.71 ±0.12	23.31 ±0.12	30.71 ±0.12	22.94 ±0.25	99.9 ±2.12	17.09 ±0.05	102.86 ±0.98	18.35 ±0.04	31.45 ±0.27	28.19 ±0.19	9.10 ±0.04	33.69 ±0.76	36.26 ±0.83	8.88 ±0.10	59.64 ±1.63	69.93 ±1.30	1.116	0.929
6	30.71 ±0.20	21.83 ±0.10	28.49 ±0.12	22.57 ±0.10	93.98 ±2.73	18.35 ±0.04	84.73 ±0.84	17.39 ±0.12	35.15 ±0.50	31.08 ±0.46	9.97 ±0.06	35.52 ±0.68	30.34 ±0.85	7.70 ±0.05	66.23 ±2.04	65.86 ±2.59	1.131	1.171
7	29.23 ±0.10	24.42 ±0.19	31.08 ±0.10	22.57 ±0.10	89.54 ±1.91	15.17 ±0.10	77.33 ±1.49	15.17 ±0.10	34.41 ±0.20	32.93 ±0.19	8.07 ±0.09	40.70 ±0.35	43.29 ±0.37	8.81 ±0.07	67.34 ±0.74	83.99 ±1.30	1.045	0.940
8	29.97 ±0.10	21.83 ±0.19	29.6 ±0.00	24.79 ±0.12	86.58 ±1.83	14.65 ±0.04	95.46 ±2.01	16.84 ±0.05	38.11 ±0.37	40.33 ±0.37	8.73 ±0.09	43.29 ±0.60	44.77 ±0.70	9.62 ±0.14	78.44 ±1.11	88.06 ±0.74	0.945	0.967
9	34.78 ±0.10	31.45 ±0.00	33.3 ±0.16	31.08 ±0.10	89.17 ±3.00	16.65 ±0.16	80.66 ±2.99	16.65 ±0.27	39.96 ±0.34	38.48 ±0.40	10.36 ±0.12	39.59 ±0.34	40.7 ±0.67	10.73 ±0.10	78.44 ±0.74	80.29 ±0.56	1.038	0.973
10	29.23 ±0.10	27.90 ±0.04	29.60 ±0.16	27.75 ±0.00	95.46 ±3.14	17.02 ±0.10	96.94 ±2.45	17.39 ±0.12	48.10 ±0.35	49.58 ±0.33	7.77 ±0.10	48.39 ±0.37	50.32 ±0.43	7.55 ±0.04	97.68 ±0.74	97.69 ±1.48	0.970	0.941
11	32.93 ±0.19	26.27 ±0.19	27.38 ±0.37	27.38 ±0.37	112.85 ±3.91	18.43 ±0.05	104.34 ±2.62	15.91 ±0.12	38.85 ±0.27	40.7 ±0.32	7.77 ±0.06	39.59 ±0.46	42.18 ±0.43	8.14 ±0.12	79.55 ±0.93	81.77 ±1.30	0.955	0.939
12	34.41 ±0.12	28.49 ±0.20	34.04 ±0.20	28.12 ±0.33	88.06 ±2.48	17.02 ±0.10	93.61 ±1.51	19.24 ±0.12	44.4 ±0.35	39.59 ±0.46	8.51 ±0.12	35.52 ±0.29	42.18 ±0.19	8.88 ±0.10	83.99 ±2.41	77.70 ±3.33	1.121	0.842

Table 2 Continued

Acc. No	Stomata Size (m)				Long Cell Size (m)				Lengths of Microhair (m)						Total Length (m)		Basal/Apical	
	Adaxial		Abaxial		Adaxial		Abaxial		Adaxial			Abaxial			Adaxial	Abaxial	Adaxial	Abaxial
	L	B	L	B	L	B	L	B	Basal cell	Apical cell	Max. breadth	Basal cell	Apical cell	Max. breadth				
13	36.63	26.27	36.63	24.42	84.88	18.28	96.2	20.28	43.66	45.88	8.07	41.81	46.99	7.77	89.54	88.80	0.952	0.890
	±0.19	±0.29	±0.10	±0.10	±2.13	±0.12	±1.70	±0.21	±0.25	±0.19	±0.13	±0.37	±0.25	±0.10	±1.11	±2.59		
14	34.60	23.02	37.80	26.60	99.8	20.10	98.60	18.60	44.79	47.50	8.15	42.04	46.70	9.75	92.29	88.74	0.943	0.900
	±0.30	±0.12	±0.40	±0.30	±2.14	±0.30	±2.01	±0.40	±0.34	±0.30	±0.07	±0.30	±0.40	±0.08	±1.36	±2.33		
15	32.56	26.64	35.89	27.75	95.46	21.09	100.64	19.61	46.99	48.47	8.07	41.07	44.77	9.69	95.46	85.84	0.969	0.917
	±0.20	±0.20	±0.20	±0.27	±2.13	±0.25	±1.59	±0.34	±0.25	±0.29	±0.09	±0.29	±0.37	±0.07	±0.74	±1.85		
16	33.3	27.01	40.7	24.42	85.84	19.61	102.12	18.87	51.43	52.91	8.21	44.77	48.47	8.88	104.34	93.24	0.972	0.924
	±0.22	±0.12	±0.35	±0.10	±2.00	±0.12	±3.37	±0.10	±0.62	±0.60	±0.08	±0.83	±0.83	±0.10	±0.74	±1.85		
17	34.41	24.42	34.41	25.16	92.87	18.87	93.24	19.61	47.73	50.69	9.03	45.51	48.1	8.81	98.42	93.61	0.942	0.946
	±0.25	±0.10	±0.12	±0.12	±2.16	±0.10	±2.75	±0.20	±0.29	±0.25	±0.06	±0.20	±0.27	±0.07	±1.48	±1.30		
18	32.93	24.79	32.93	25.53	85.84	19.24	85.10	19.98	48.84	52.54	7.55	44.77	49.58	9.03	101.38	94.35	0.930	0.903
	±0.10	±0.12	±0.19	±0.10	±1.56	±0.12	±2.72	±0.24	±0.82	±0.70	±0.04	±0.51	±0.43	±0.06	±1.85	±2.41		
19	29.23	24.79	35.15	24.79	100.64	18.65	80.66	19.61	36.26	39.96	9.47	44.40	48.47	10.36	76.22	92.87	0.907	0.916
	±0.33	±0.12	±0.16	±0.30	±0.86	±0.04	±2.08	±0.2	±0.20	±0.30	±0.06	±0.22	±0.29	±0.12	±1.85	±2.04		
20	32.93	27.38	32.93	27.38	99.9	17.02	96.94	18.13	45.51	48.84	8.88	44.77	48.1	8.81	94.35	92.87	0.932	0.931
	±0.24	±0.19	±0.24	±0.19	±2.49	±0.19	±0.45	±0.10	±0.34	±0.25	±0.10	±0.27	±0.42	±0.07	±1.67	±1.67		
21	33.3	28.12	34.41	25.90	98.42	16.28	107.3	18.13	40.7	43.66	10.80	39.96	42.18	10.95	84.36	82.14	0.932	0.947
	±0.16	±0.48	±0.2	±0.45	±1.50	±0.19	±2.25	±0.10	±0.16	±0.12	±0.05	±0.25	±0.27	±0.04	±1.48	±1.11		
22	32.93	18.9	34.04	23.31	88.8	19.61	93.98	19.98	44.77	47.36	8.51	42.55	45.14	10.73	92.13	87.69	0.945	0.943
	±0.10	±0.12	±0.12	±0.25	±2.35	±0.12	±2.38	±0.19	±0.19	±0.20	±0.12	±0.22	±0.34	±0.10	±1.30	±1.30		
23	31.82	21.09	31.45	25.16	88.06	17.76	99.9	17.02	44.03	46.99	9.32	44.4	47.36	10.36	91.02	91.76	0.937	0.938
	±0.19	±0.20	±0.00	±0.12	±3.14	±0.12	±3.39	±0.10	±0.29	±0.30	±0.02	±0.35	±0.25	±0.12	±1.48	±1.48		
24	33.67	25.16	30.34	26.64	82.14	18.5	84.36	15.91	44.4	46.99	9.25	39.96	48.47	10.36	91.39	88.43	0.945	0.824
	±0.10	±0.12	±0.12	±0.12	±2.91	±0.16	±3.02	±0.12	±0.27	±0.25	±0.00	±0.20	±1.61	±0.12	±0.77	±4.26		

Table 2 Continued

Acc. No	Stomata Size (m)				Long Cell Size (m)				Lengths of Microhair (m)						Total Length (m) Basal/Apical			
	Adaxial		Abaxial		Adaxial		Abaxial		Adaxial			Abaxial			Adaxial	Abaxial	Adaxial	Abaxial
	L	B	L	B	L	B	L	B	Basal cell	Apical cell	Max. breadth	Basal cell	Apical cell	Max. breadth				
25	29.97	21.83	34.78	28.12	86.58	19.09	90.28	14.8	43.66	46.25	8.51	40.7	44.4	10.43	89.90	85.10	0.944	0.917
	±0.24	±0.24	±0.10	±0.43	±2.09	±0.21	±2.06	±0.00	±0.25	±0.22	±0.12	±0.52	±0.52	±0.09	±1.30	±1.85		
26	26.64	22.94	24.05	23.87	75.48	17.39	91.02	17.39	38.11	40.7	7.92	31.45	35.15	10.73	78.81	66.60	0.936	0.895
	±0.12	±0.12	±0.16	±0.09	±1.21	±0.12	±2.23	±0.12	±0.60	±0.71	±0.06	±0.39	±0.57	±0.10	±1.30	±1.85		
27	22.57	22.2	22.94	22.57	98.42	14.36	90.28	14.8	27.01	29.97	9.84	34.78	37.74	9.69	56.98	72.52	0.901	0.922
	±0.24	±0.22	±0.12	±0.10	±3.26	±0.05	±3.11	±0.00	±0.49	±0.43	±0.10	±0.29	±0.12	±0.07	±1.48	±1.48		
28	32.19	27.38	23.85	31.08	98.05	21.83	96.2	25.9	51.06	54.39	8.88	42.18	44.77	10.36	105.45	86.95	0.939	0.942
	±0.30	±0.19	±0.27	±0.040	±2.94	±0.24	±2.77	±0.16	±0.97	±0.72	±0.10	±0.56	±0.60	±0.12	±1.67	±1.30		
29	30.18	26.14	39.80	29.04	101.06	22.84	99.3	22.0	45.02	52.30	9.60	40.19	43.70	10.12	97.32	83.89	0.861	0.920
	±0.25	±0.18	±0.30	±0.52	±3.01	±0.25	±3.10	±0.20	±0.60	±0.80	±0.20	±0.60	±0.58	±0.11	±3.64	±1.76		
30	26.64	24.42	30.34	25.97	87.32	17.39	90.28	17.76	34.04	37.00	8.51	42.92	44.4	8.88	71.04	87.32	0.920	0.967
	±0.12	±0.10	±0.34	±0.19	±2.98	±0.12	±3.14	±0.12	±0.45	±0.27	±0.12	±0.58	±0.42	±0.10	±1.48	±0.74		
31	31.82	25.16	31.82	29.6	83.60	23.31	95.46	16.28	45.51	42.92	9.62	45.51	45.51	11.25	88.43	91.02	1.060	1.000
	±0.10	±0.20	±0.19	±0.00	±2.06	±0.20	±2.71	±0.10	±0.54	±0.60	±0.10	±0.20	±0.46	±0.04	±1.30	±0.00		
32	32.93	25.16	32.93	25.16	90.28	19.61	85.84	18.87	42.18	44.77	10.73	34.41	37.37	13.69	86.95	71.78	0.942	0.921
	±0.10	±0.20	±0.19	±0.20	±2.36	±0.12	±2.31	±0.10	±0.58	±0.70	±0.10	±0.25	±0.19	±0.12	±1.30	H.48		
33	31.08	25.53	33.3	29.23	119.14	19.24	102.12	16.67	41.07	43.66	9.62	35.15	35.89	10.73	84.73	71.04	0.941	0.979
	±0.10	±0.19	±0.16	±0.10	±3.40	±0.12	±3.75	±0.16	±0.04	±0.34	±0.10	±0.71	±0.75	±0.10	±1.30	±0.37		
34	33.3	25.90	33.3	26.27	91.76	19.61	87.32	18.87	42.55	45.14	10.36	35.52	38.48	10.36	87.69	74.00	0.943	0.923
	±0.16	±0.16	±0.22	±0.29	±2.27	±0.12	±2.80	±0.10	±0.35	±0.34	±0.12	±0.74	±0.68	±0.12	±1.30	±1.48		
35	42.18	31.08	40.7	29.6	100.64	20.72	96.94	21.09	53.65	56.61	8.88	42.18	45.51	9.99	110.26	87.69	0.948	0.927
	±0.29	±0.37	±0.32	±0.32	±1.93	±0.10	±3.29	±0.12	±0.55	±0.64	±0.10	±0.68	±0.72	±0.12	±1.48	±1.67		