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Taxonomic Considerations on the Bast Fibres in the Genus *Sida* L. (Malvaceae) in Nigeria

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ABSTRACT

The distributional pattern of the bast fibres strands or bundles in the stems of *Sida* species represented in Nigeria is studied. Three major patterns of arrangement are recognized, namely aggregation of fibre strands into units with wedge-shaped, or triangular, rectangular, rhomboidal, square and trapezoid outlines; serial arrangement of fibre strands into rings or circular, ovoid, semi-circular or crescentic rows; and intermediate pattern in which both fibre strands-aggregates and serial rows of strands patterns are combined. The first pattern is found in *S. linifolia*, *S. urens* and *S. scabrida*, the second in *S. cordifolia*, *S. pilosa*, *S. ovata*, *S. rhombifolia* and *S. spinosa*, and the third in *S. garckeana*, and *S. acuta*. A dichotomous key based on these features is presented. Dimensional characteristics of the bast fibre cells are also given.

INTRODUCTION

The genus *Sida* L. is represented in West Africa and Nigeria by ten species (Hutchinson and Dalziel, 1958; Ugborogho, 1980). Descriptions of the species in the Flora of West Tropical Africa and in the taxonomic evaluation of the species by Ugborogho (1980) were based on the vegetative and reproductive morphological features. More recently, Ugborogho (1982a, 1982b), Scott-Emuakpor and Ugborogho (1980) elucidated the cytological relationships in the genus. However, there is little or no information in the literature, on the taxonomic significance of the bast fibre components in these *Sida* species. Sclerenchyma has been shown to be one of the important anatomical characters of systematic value in dicotyledons (e.g., by Metcalfe and Chalk, 1950; Richter, 1981). The object of this paper is, therefore, to highlight the patterns of bast fibre distribution in this relatively unexploited group of bast fibre plants with a view to assessing the taxonomic significance of the fibre characteristics.

MATERIALS AND METHODS

Fresh stem specimens of 10 species of *Sida* were collected from various locations in Kwara and Oyo states of Nigeria. Voucher herbarium specimens were prepared and deposited at the

Ilorin University Herbarium (IUH). Studies on *S. ovata* were on herbarium specimen obtained from the Forestry Herbarium at the Forestry Research Institute of Nigeria, Ibadan (Table 1). Transverse and longitudinal sections of stems of comparable diameter (2 mm to 4 mm) were prepared using a Reichert sledge microtome. The sections were stained in 1% aqueous safranin solution and mounted in glycerine jelly. Observations were recorded with camera lucida drawings/and photographs. Measurements of fibre cell dimensions were made on sectioned and isolated fibres. Maceration of tissue was in hot 5% potassium chlorate solution in 50% nitric acid for 1~2 min. (Jane, 1962).

RESULTS

There are 3 levels of arrangement or aggreation of the phloem or bast cells in all the species studied. There is a primary level of organization in which the fibre cells are grouped into tight fibre strands or bundles with little or no intercellular spaces (Figs. 1, 2 and 3). These strands are in transverse section of variable shapes regular or irregular (Figs. 1-3).

There is a secondary level of arrangement in which the fibre strands with intervening secondary phloem tissues (sieve tube members, companion cell and phloem parenchyma), are grouped into recognizable units or aggregates. These units, in transverse section, have different geometric shapes, which may be used to characterize taxa. There are firstly, wedge-shaped or triangular, trapezoid, square and rectangular strands observable in *S. linifolia*, *S. acuta*, *S. garckeana*, *S. urens*, and *S. scabrida*. These forms are here, collectively designated Type A units or aggregates (Figs. 1-3; 7-11; Table 2). There are secondly, linear forms of units, consisting of serially continuous fibre strands, observable in *S. cordifolia*, *S. pilosa*, *S. ovata*, *S. rhombifolia* and *S. spinosa*. These forms are referred to as Type B units or aggregates (Figs. 4-6, 12-16; Table 2).

At the tertiary level of organization, the fibre strand units or aggregates are arranged round the stem in 3 recognizable patterns, which may also distinguish between taxa. (a) Type I pattern: only Type A units or aggregates occur exclusively round the stem as in *S. linifolia* and *S. scabrida* (Figs. 7 and 11; Table 2). (b) Type II pattern: only Type B units or aggregates occur exclusively round the stem, as in *S. cordifolia*, *S. pilosa*, *S. ovata*, *S. rhombifolia* and *S. spinosa*. Within this group, there are 2 subtypes; (i) fibre strands occur in a single row round the stem as in *S. cordifolia*, *S. pilosa* and *S. ovata* (Figs. 12, 13 and 14; Table. 2) and (ii) fibre strands occur in 2 concentric, circular rows as in *S. rhombifolia* (Fig. 15), or in an outer circular row and an inner, semi-circular or crescentic row as in *S. spinosa* (Fig. 16). (c) Type III pattern: Type A units of strands occur on one side of the stem and Type B units on the other, as in *S. acuta*, *S. urens* and *S. garckeana* (Figs. 8-10; Table 2). This pattern is more or less intermediate between Types I and II patterns.

Table 1. Information on the plant materials collected

Name of Taxa	Locality	Date of Collection	Collector's Name and Number
Sida acuta Burm. var. 1	Forest Wood Land, Forestry Research Institute of Nigeria, Ibadan.	26th October, 1984	Ake Moses Dele 3
Sida acuta Burm. var. 2	Along Alapa, River bank, Ogbomosho, Oyo State.	2nd November, 1984	Ake Moses Dele 21
Sida spinosa (L.) Ugborogho	At the back of Amusement Park, Ilorin, Kwara State.	3rd November, 1984	Ake Moses Dele 17
Sida cordifolia L.	Savanna grass land; on football field of L.S.M.B Primary School Lade, Edu L.G.A., Kwara State.	8th November, 1984	Ake Moses Dele 19
Sida garckeana Polak.	University Quarters, University of Ibadan, Ibadan.	27th October, 1984	Ake Moses Dele 6
Sida linifolia Juss. ex Cav.	Savanna grass land found on football field of L.S.M.B. Primary School, of Lade, Edu L.G.A., Kwara State	8th November, 1984	Ake Moses Deel 18
Sida ovata Forsk.	Around Eruwu town Ibarapa L.G.A. Oyo State	15th February, 1979	Ibanesebhor & Adedeji FHI 23751
Sida rhombifolia L. var. 1	Along Alapa, River Bank, Care-taker, Ogbomosho, Oyo State	2nd November, 1984	Ake Moses Dele 5
Sida rhombifolia L. var. 2	Along Alapa, River Bank, Care-taker, Ogbomosho, Oyo State.	2nd November, 1984	Ake Moses Dele 14
Sida scabrida Wight & Arn.	University of Ibadan near the university gate.	28th October, 1984	Ake Moses Dele 1
Sida acuta subsp. *carpinifolia* (Cav.) Ugborogho	University of Ibadan, Staff Quarters	27th October, 1984	Ake Moses Dele 8
Sida urens L.	'Gbakogi farm, Savanna forest area Lade, Edu L.G.A., Kwara State,	9th November, 1984	Ake Moses Dele 20
Sida pilosa (Retzius) Ugborogho	University of Ibadan between Bookshop and Teddar Hall	30th October, 1984	Ake Moses Dele 13

Table 2. Organization and dimensions of the bast fibre cells in *Sida* spp.

Taxa	Type of fibre organization		Fibre cell dimensions			
	2°	3°	Cell length (μm)	Cell diameter (μm)	Lumen diameter (μm)	Wall thickness (μm)
Sida linifolia	Type A	Type I	2.0±0.6	16.8±2.9	2.6±0.4	7.1±1.5
S. acuta	Type A	Type III	2.0±0.9	11.5±1.3	2.6±0.9	4.6±1.3
S. garckeana	Type A	Type III	2.2±0.5	12.3±0.4	2.4±0.4	4.9±0.8
S. urens	Type A	Type III	2.9±0.7	18.0±4.2	3.9±1.5	7.1±1.5
S. scabrida	Type A	Type I	3.5±1.1	14.4±3.0	2.8±0.5	5.8±1.5
S. cordifolia	Type B	Type II(i)	2.0±0.8	16.2±3.5	3.5±1.5	6.4±1.5
S. pilosa	Type B	Type II(i)	3.0±0.8	17.2±2.5	3.7±1.5	6.9±1.0
S. ovata	Type B	Type II(i)	2.9±0.6	16.9±0.9	3.2±0.8	6.9±0.5
S. rhombifolia	Type B	Type II(ii)	2.5±0.8	12.4±0.9	2.2±0.3	5.1±0.5
S. spinosa	Type B	Type II(ii)	3.8±0.9	14.1±2.4	3.1±0.9	5.5±1.0

The mean value with standard deviations of the fibre cell dimensions is as presented in Table 2. The longest fibre is found in *S. spinosa* and the shortest in *S. linifolia* and *S. acuta*. The widest fibre occurs in *S. urens* and the narrowest in *S. acuta*. The thickest cell wall is found in *S. linifolia* and *S. urens* (Table 2).

DISCUSSION

Three major patterns of arrangement of bast fibre strands in the stems of the *Sida* species studied are recognized. There is an aggregation of fibre strands into geometric units with wedge-shaped, triangular, rectangular, square, rhomboidal or trapezoid outlines. This pattern is found in *S. linifolia* and *S. scabrida*, which may possibly form a section of the genus (Section I). There is also a serial arrangement of fibre strands into circular, ovoid, semi-circular or crescentic rows. This pattern is found in *S. cordifolia*, *S. pilosa*, *S. ovata*, *S. rhombifolia* and *S. spinosa*, which may form another section of the genus (Section II). There is a third pattern, apparently intermediate in structure, whereby fibre-strand aggregates occur in association with serially arranged fibre strands. This pattern is found in *S. acuta*, *S. garckeana*, and *S. urens* which may also form another section the genus (Section III). Two members of the latter group, namely *S. acuta* and *S. garckeana* have previously been reported to be genetically and cytologically related (Scott-Emuakpor and Ugborogho, 1980). Moreover, with respect to the fibre cell dimensions, both species have short and narrow fibres (Table 2).

Characterizing these probable sections with fibre cell dimensions may be inadequate, it is however, noteworthy that bast fibres are relatively long and broad in membres of section II (Table 2). They are relatively short and narrow in section III with the exception of *S. urens*, which has very long and broad fibres. The fibres in section I are either long and

narrow as in *S. scabrida* or short and broad as in *S. linifolia* (Table 2). While a wider range of characters including cytological attributes of the plants would prove useful in elucidating the relationships at the sectional level in this genus, it is for the moment, possible to identify the respective species using the distributional pattern and transectional outlines and shape of bast fibre strands in the stem. A dichotomous key is therefore presented below. The consistently similar features of the bast fibres in the 3 varieties of *S. acuta* or 2 varieties of *S. rhombifolia* examined, indicated that bast fibres alone may not clearly discriminate between taxa at varietal or subspecific levels.

Key to the Genus *Sida* L.

1. Units or aggregates of fibre strands, wedge-shaped or triangular, square, rectangular (Type A units or aggregates) 2
   2. Type A units of fibre strands, exclusively round the stem 3
      3. Fibre cell length, 2.0 mm ..... *linifolia*
      3. Fibre cell length, 3.5 mm ..... *scabrida*
   2. Type A units of fibre strands, on one side of stem, Type B units on the other 4
      4. Fibre cell diameter, 11.5 μm or less ..... *acuta*
      4. Fibre cell diameter, greater than 115 μm 5
         5. Cell wall thickness, 4.9 μm ..... *garckeana*...
         5. Cell wall thickness, 7.1 μm ..... *urens*
1 Units or aggregates of fibre strands, linear and serially contiguous (Type B units) 6
   6. Type B units in a single row round the stem 7
      7. Units wide ..... *cordifolia*
      7. Units narrow 8
         8. Units long, about 200 μm ..... *pilosa*
         8. Units short, about 100 μm *ovata*
   6. Type B units either in 2 concentric rows or in 1 outer circular row and 1 semicular or crescentic row 9
      9. Rows of strands concentric ..... *rhombifolia*
      9. Outer row of strands circular; inner row semi-circular or crescentic .. .. *spinosa*

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EXPLANATION OF FIGURES

Fig. 1. Transverse section of *Sida scabrida*, showing fibre strands(s), aggregated into a Type A, wedge-shaped or triangular unit. Note the surrounding secondary phloem cells (p); cf. Fig. 11. Bar=250 μm.

Fig. 2. T.S. stem *S. linifolia*, showing a triangular, Type A aggregate of fibre strands (arrow-heads); of Fig. 7. Bar=300 μm.

Fig. 3. T.S. stem *S. garckeana*, showing a trapezoidal, Type A aggregate of fibre strands of Fig. 9. Bar=190 μm.

Fig. 4. T.S. stem *S. pilosa*, showing a long linear Type B aggregate of fibre strands; of Figs. 12 and 13. Bar=85 μm.

Fig. 5. T.S. stem *S. ovata*, showing a short linear Type B aggregate of fibre strands; cf Fig. 14. Bar=88 μm.

Fig. 6. T.S. stem *S. rhombifolia*, showing two linear Type B aggregates, an outer large unit(o) and an inner thinner unit(i). The inner aggregate is more or less made up of a single row of fibre cells; cf Figs. 15 and 16. Bar=60 μm.

Fig. 7. T.S. stem *S. linifolia*. Wedge-shaped fibre strand aggregates (f), arranged peripherally in the stem. Bar=0.46 mm. x, secondary xylem; p, secondary phloem.

Fig. 8. T.S. stem *S. acuta*. Fibre strand aggregates on one side of the stem and serially arranged fibre strands on the other. Bar=0.50 mm.

Fig. 9. T.S. stem *S. garckeana*. Distribution of fibre strand aggregates similar to that of Fig. 8. Bar=0.48 mm.

Fig. 10. T.S. stem *S. urens*. Distribution of fibre strand aggregates similar to those of Figs. 8 and 9. Bar=0.36mm.

Fig. 11. T.S. stem *S. scabrida*. Fibre strand aggregates triangular trapezoid in large and small sizes. Bar=0.42 mm.

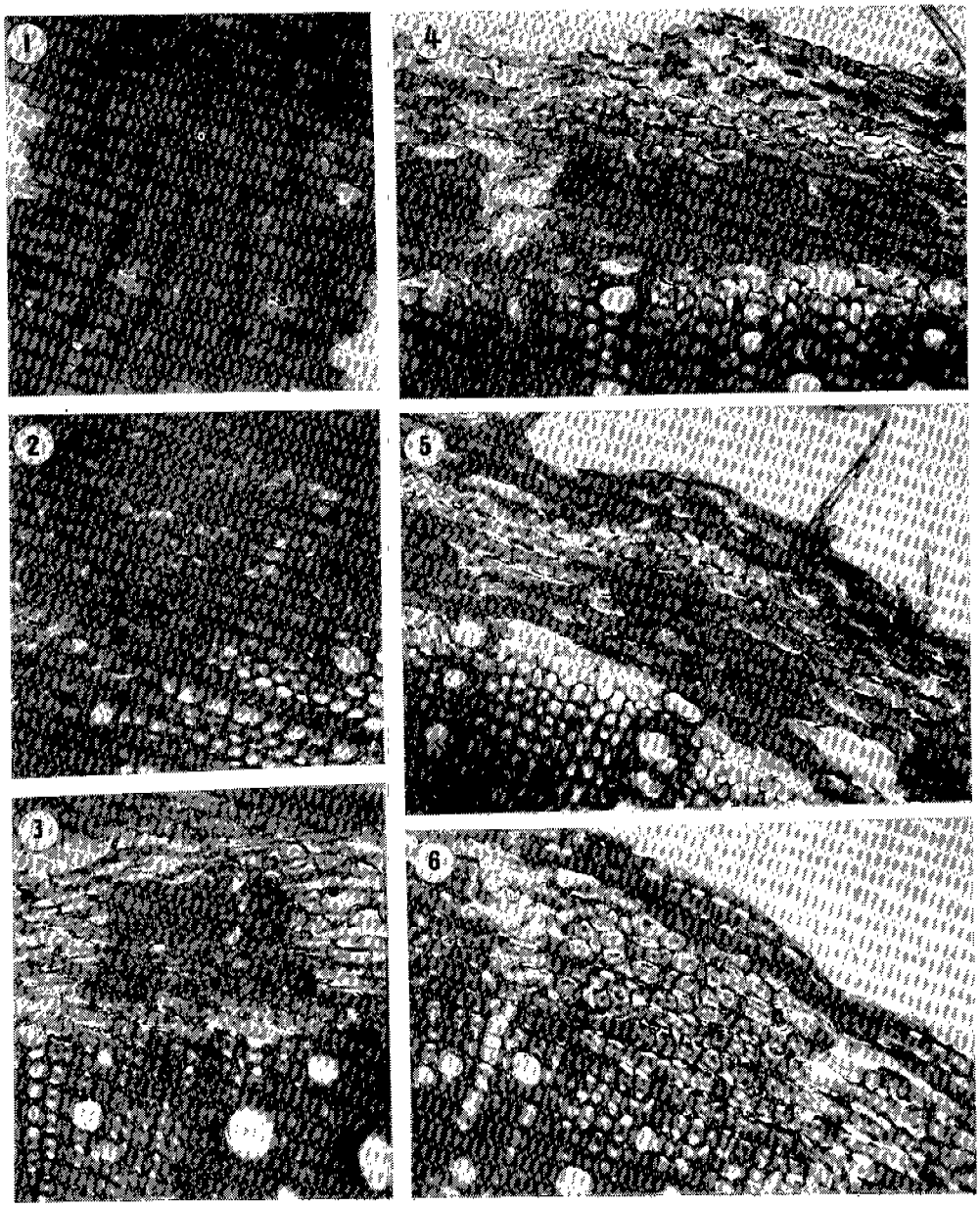
Fig. 12. T.S. stem *S, cordifolia*. Fibre strands linearly arranged in an ovoid row with wider gaps at the flanks of the relatively compressed stem. Bar=0.52 mm.

Fig. 13. T.S. stem *S. pilosa*. Fibre strands arranged in a circular row. Bar=0.46 mm.

Fig. 14. T.S. stem *S. ovata*. Fibre strands serially arranged in a circular row. Strands more spaced out than in Fig. 13. Bar=0.48 mm.

Fig. 15. T.S. stem *S. rhombifolia*. Fibre strands serially arranged in 2 circular rows, the outer row having larger strands in the inner row. Bar=0.54 mm.

Fig. 16. T.S. stem *S. spinosa*. Fibre strands serially arranged in 2 rows; outer, circular; inner, semi-circular or crescentic. Bar=0.64 mm.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