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Taxonomic status of certain members of *Smilax* Linnaeus (Smilacaceae) based on foliar epidermal structures

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Abstract

Foliar epidermal characters, both qualitative (cell and cell wall nature, stomata) and quantitative (length, breadth and number of epidermal cell, distribution of stomata and stomatal index), of four species of *Smilax* Linnaeus (Smilacaceae) have been studied under light microscope. The observed characters were found helpful in distinguishing the species. The present paper is an attempt to evaluate foliar epidermal features as an aid to identification of different taxa under study.

Key words: Taxonomy, Foliar epidermis, Artificial key, *Smilax*

INTRODUCTION

The genus *Smilax* Linnaeus belongs to the family Smilacaceae is distributed throughout the tropical and temperate regions of the world. Species of *Smilax* L. are shrubs, vines or herbs; perennial, rhizomatous or non rhizomatous. Stems erect or climbing, usually prickly, sometimes unarmed and the leaves are with reticulate venation. The leaf-blade of *Smilax* is not equivalent to the lamina of a dicotyledonous but is merely a pseudolamina representing an expansion of the upper region of the petiole (Arber 1920). The flowers are borne on the axils of leaves in umbels, dioecious, bracteate, actinomorphic, trimerous, hypogynous; tepals 3 + 3, free, petaloid; stamens 3 + 3; carpels 3, syncarpous; overy superior, trilocular, placentation axile; fruits berry**.** The family Smilacaceae was separated by Hutchinson (1959) from the polyphyletic family Liliaceae and this treatment was followed by many of the botanists subsiquently (Dahlgren 1975; Dahlgren *et al* 1985; Cronquist 1981, 1988; Takhtajan 1987; Conran 1998).The Smilacaceae comprises of 375 species (Heywood *et al* 1993) widely distribution in tropics and subtropics. The family is characterized by reticulate venation, paired petiolar tendrils and mostly woody, climbing stem. Dahlgren (1975) included four genera under the family, viz., *Smilax* Linnaeus, *Heterosmilax* Kunth, *Pseudosmilax* Hayata and *Ripogonum* J.R. & G. Forster, whereas Takhtajan (1997) recognized only two genera *viz*., *Smilax* (including *Pseudosmilax*) and *Heterosmilax*.

Although external morphological characters have been traditionally used in plant taxonomy approaches combining the attributes derived from other branches of botany has often proved to be more effective in ascertaining the proper taxonomic categorization of taxa (Constance 1964). Morphological characters in combination with the microscopic characters of leaves often greatly enhanced the taxonomic judgment of angiosperm systematics (Erdtman 1952; Carlquist 1961; Dickinsion 1975; Barthlott 1981). The leaf epidermal structure of some members of Apocynaceae has been studied significantly changed the taxonomy of the family (Chandra *et al* 1972). The taxonomic importance of epidermal characters of leaves in angiosperms has been emphasized also by Stace (1965, 1984). The role of the foliar epidermal characters in differentiation of taxa upto the rank of species is well established (Adedeji 2004; Kadiri 2006). Systematic studies on

the development and morphology of stomata may be expected to provide clues to the various evolutionary trends among the angiospermous families and helpful in assigning taxa of uncertain affinity to their position.

A number of the epidermal structures have been successfully used to differentiate certain species of *Smilax* in Thailand (Moore 2007). The analysis and use of epidermal characters of leaves is recognized as a useful taxonomic tool to distinguish between individual taxon in the absence of floral material (Moore *et al* 2008).

METERIAL AND METHODS

Live specimens in the field gene bank (FGA) maintaining in NEDFi Research & Development Centre, Khetri have been studied for their macro-morphological characters and recorded in a note book. Voucher specimens were preserved in the form of herbarium specimen as per standard field and herbarium techniques (Jain & Rao 1977).

The foliar materials, both young and mature, collected afresh from the plants maintained in the field gene bank (FGA) of NEDFi Research & Development Centre, Khetri. Both upper and lower epidermal peels were taken out mechanically or by scrapping off with the help of blade using 10 % aqueous solution of nitric acid following the techniques of Boulos & Beakbane (1971). The peels were stained with 1 % aqueous saffranine solution and after proper washing semi-permanent slides were prepared by mounting with 1 % glycerin. The ridge of the cover slip was ringed with nail varnish to check dehydration. Camera lucida drawing and microphotograph were taken from the prepared slides. The nature and distribution of stomata, epidermal cells, cell size, stomatal index were worked out for both upper and lower epidermis. Petiole size is being considered by length and breadth.

Stomatal Index was calculated by the following formula:

$$\text{Stomata index (S.I.)} = \frac{S}{S+E} \times 100 \text{ (Metcalfe \& Chalk 1979)}$$

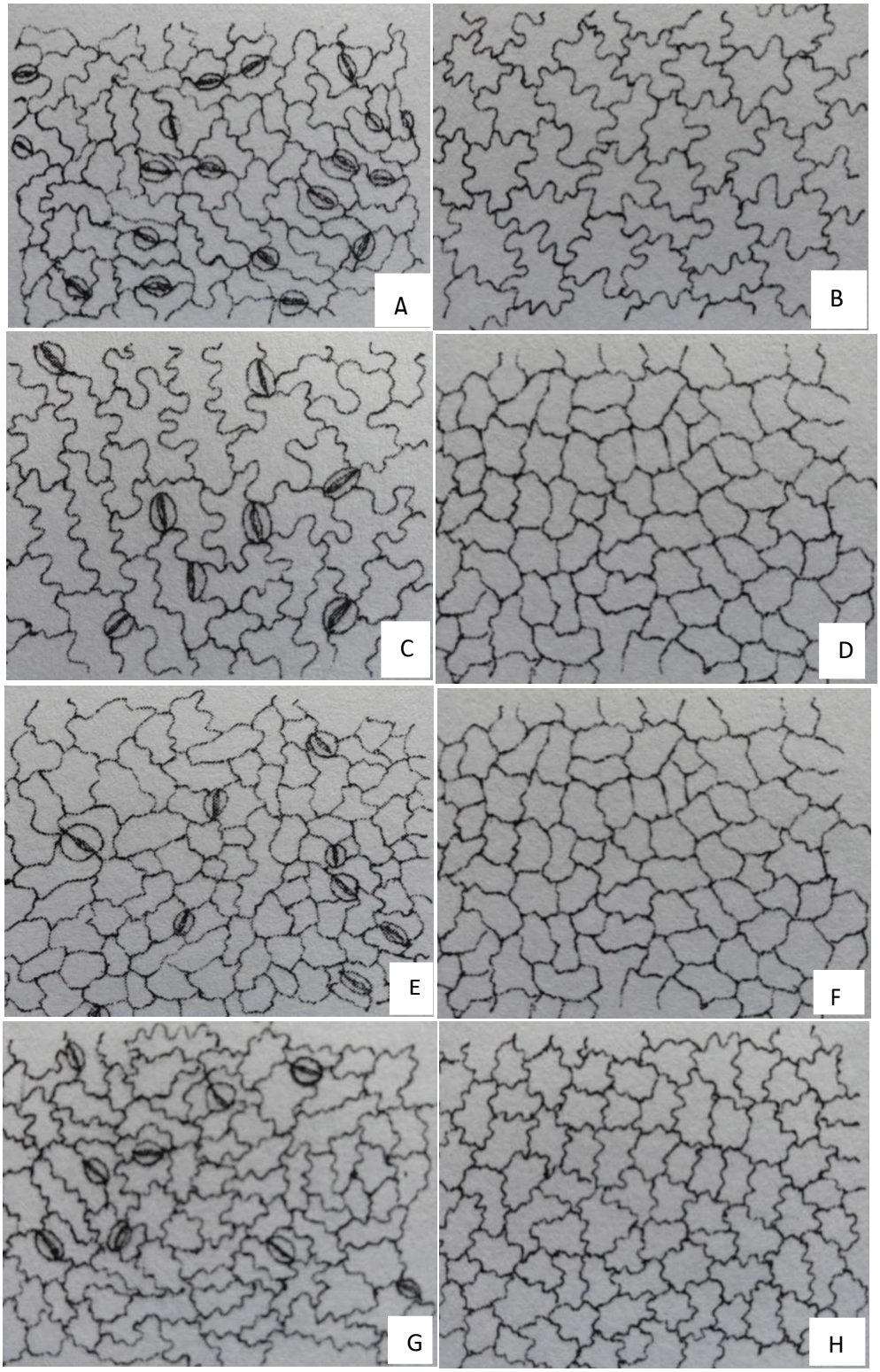
Where, S = The number of stomata per vision.
E = Number of epidermal cell per vision.

RESULTS AND DISCUSSION

The results of the quantitative micro-morphological survey has been presented below in Tables 1 & 2.

Table 1. Quantitative morphological data of *Smilax glabra, Smilax macrophylla, Smilax prolifera* and *Smilax orthoptera.*

Name of taxa	Lamina						Petiole	
	Area mm^2	Shape	Margin	Apex	Base	Texture	Size mm^2	Shape
Smilax glbra Roxburgh [NEDFi R & D 116, 117]	406.52	Lancceo-late	Entire	Acum-inate	Round	Coriaceous	2.02	Narrowly winged
Smilax macrophylla Roxburgh [NEDFi R & D 112, 115]	2210.57	Ovate	Entire	Mucro-nate	Round	Coriaceous	16.67	Narrowly winged
Smilax prolifera Roxburgh [NEDFi R & D 451, 550]	1295.92	Narrowly ovate	Entire	Mucro-nate	Sub-oblique	Coriaceous	13.44	Auriculate
Smilax orthoptera A. DC. [NEDFi R & D 539, 544]	2572.06	Ovate	Entire	Acum-inate	Slightly oblique	Coriaceous	21.5	Auriculate



A

PLATE 1. Camera lucida drawings: A & B. *Smilax glabra*; C & D. *Smilax macrophylla*; E & F. *Smilax prolifera*; G & H. *Smilax orthoptera*. [Magnifications: A,B,C,D,E,F,G,H = 10X x 10X]

Table 2. Qualitative data of foliar epidermal cells of the different species of *Smilax glabra, Smilax macrophylla, Smilax prolifera* and *Smilax orthoptera.*

Different species	Epidermal Cell				Epidermal cell/mm^2		Stomata/mm^2		S.I.	
	Length (mμ)		Breadth (mμ)							
	UE	LE	UE	LE	UE	LE	UE	LE	UE	LE
S. glabra	84.31	88.22	33.27	28.18	2134.2	2800.5	-	1200	-	24.79
S. macrophylla	99.88	95.34	43.27	32.35	1290	1590	240	498.75	8.33	20.56
S. prolifera	50.92	49.25	27.99	22.89	3720	7098	-	1440	-	15.78
S. orthoptera	59.43	68.55	23.54	22.65	5340	4800	-	1098	-	12.99

UE - Upper epidermis ; LE - Lower epidermis ; S.I. - Stomatal index.

Epidermal characters:

The epidermal cells in all the four species of *Smilax* Linnaeus studied are polygonal with sinuous to deeply sinuous cell wall (figs. 1, 2, 3 & 4). Maximum length and breadth of epidermal cells of lower and upper epidermis are found to be 95.34 x 32.35 μm and 99.88 x 43.27 μm respectively in *S. macrophylla*. Likewise, minimum length and breadth of epidermal cell size were observed in *S. prolifera* 49.25 x 22.89 μm and 50.92 x 27.99 μm respectively (Table- 2). However, the distribution of epidermal cells in both the upper and lower epidermis varies in both the species (Table-2). In case of *S. orthoptera* maximum distribution of the epidermal cells has been recorded in both the upper and lower surfaces. In upper epidermis it is 5340/ mm^2, while in lower epidermis it is 4800/ mm^2. Likewise, minimum distribution of epidermal cells was observed in *S. macrophylla* which is 1290 per mm^2 and 1590/ mm^2 in upper and lower epidermis respectively.

Stomata:

The stomata are generally anomocytic and are usually distributed on lower epidermis only. However, in *S. macrophylla* stomata were distributed in both the upper and lower surfaces. The stomatal index significantly varied in all the four species studied (Table 2). Stomata with single guard cell and contiguous stomata are common features of species studied. The distribution of stomata varied from species to species. Among the species of *Smilax* distribution of stomata in the lower epidermis was maximum (1400 per mm^2) in the *S. prolifera* and minimum (498.75 per mm^2) in *S. macrophylla*. Likewise, maximum stomatal index was found in *S. glabra* (24.79) while it was minimum (12.99) in *S. orthoptera*.

An artificial key:

1. Stomata on both lower and upper epidermis. Stomatal frequency and stomatal index on lower epidermis 498/mm^2 and 20.56 respectively, whereas in upper epidermis 240/mm^2 and 8.33. Epidermal cells deeply sinous on both surfaces ..... *S. macrophylla*
1. Stomata on lower epidermis only. Epidermal cells deeply sinous wavy or angular …. 2
2. Epidermal cells on both the surfaces pentagonal to polygonal. Stomatal Index and frequency 15.78 and 1440/mm^2 respectively ……..…….... *S. prolifera*
2. Epidermal cells on both the surfaces not angular but wavy or sinuos ……. 3
3. Epidermal cells deeply sinuus on both surfaces. Stomatal index and frequency 12.99 and 1098/mm^2 respectively ……..…….... *S. orthoptera*
3. Epidermal cells wavy on both surfaces. Stomatal Index and frequency 24.99 and 1200/ mm^2 respectively ……..... *S. glabra*

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LITERATURE CITED

Adedeji, O. 2004. Leaf Epidermal Studies of *Emilia* Cass. (Senecioneae, Asteraceae) in Nigeria. *Botanica Lithuanica* 10(2): 12 – 133.

Arber, A. 1920. Tendrils of *Smilax*. *Bot. Gaz.* 69(5): 438 – 442.

Barthlott, W. 1981. Epidermal and seed surface characters of plants: Systematic applicability and some evolutionary aspects. *Nord. J. Bot.* 1: 345 – 355.

Boulus, S.T. & Beakbane, A.B. 1971. A chemical method for separating leaf epidermis from mesophyll tissue. *U.A.R. J. Bot.* 14: 317 – 322.

Carlquist, S. 1961. *Comparative plant anatomy*. Mc. Graw Hills pub., Newyork.

Chandra, V.R.; Mitra, R. & Kapoor, L.D. 1972. Epidermal and venation studies in Apocynaceae *Ind. J. Pharm.* 14: 76 – 82.

Constance, L. 1964. Systematic Botany an unending synthesis. *Taxon* 13: 257 – 273.

Conran, J.G. 1998. Smilacaceae. In: Kubitzki K ed. The Families and Genera of Vascular Plants. Vol.3. Flowering Plants. Monocotyledons: Lilianae (except orchidaceae). Berlin: Springer-Verlag. 417 – 422.

Cronquist, A. 1981. *An Integrated System of Classification of Flowering Plants*. New York: Columbia University Press. 1262 – 1263.

Cronquist, A. 1988. *The Evolution and Classification of Flowering Plants*. 2ND ed. New York: New York Botanical Garden Press. 555- 556.

Dickinsion, S. 1975. The bases of angiosperm phylogeny: vegetative anatomy. *Ann. Missouri Bot. Gdn.* 62: 590 – 620.

Dahlgren, R.M.T. 1975. *A system of classification of the angiosperms to be used to demonstrate the distribution of characters*. Botaniska Notiser (Lund) 128: 119 – 147.

Dahlgren, R.M.T.; Clifford, H. T. & Yeo, P. F.1985. *The Families of the Monocotyledones. Structure, Evolution and Taxonomy*. Springer-Verlag.

Erdtman, G. 1952. *Pollen Morphology and plant taxonomy I. Angiosperms*. Almquist and wiksell, Stockholm

Heywood, V.H.; Moore, D.M. & Stearn, W.T. 1993. *Flowering Plants of the World*. Updated ed. New York: oxford University Press. 320.

Hutchinson, J. 1959. *The families of flowering plants II monocotyledonous*. New York *(cf. Amaryllidaceae*. Pp. 128 – 135).

Jain, S.K. & Rao, R.R. 1977. *A hand book of Field and Herbarium Tachnique*. Today & Tomorrow Publication, New Delhi.

Kadiri, A.B. 2006. Comparative foliar micro-morphological characters of the species of Protulacaceae in Nigeria. *Bull. Pure Appl. Sci.* 25B(1): 21 – 26. www. Bulletinpureappliedsciences.com

Metcalfe, C.R. & Chalk, L. 1979. *Anatomy of the Dicotyledons*. 2nd ed. Vol.1. Oxfored University Press, Oxford.

Moore, B.R. 2007. *Assessing epidermal characters and stomatal frequency of extant Smilacaceae "Catbriar" modern, historical and paleontological applications*. Pub. Ph.D dissertation, Mahasarakhan University, Mahasarakhan, Thailand.

Moore, B.R.; Narkkong, N.A.; Moore, T. & Lutat, P. 2008. Epicular leaf architecture confirm a new species (Smilacaceae) from Northeast Thailand. *Sci. Asia* 34: 103 – 106.

Stace, C.A. 1965. Cuticular studies as an aid to plant taxonomy. *Bull. Brit. Mus. Bot.* 4(1): 1 – 78.

Stace, C.A. 1984. The taxonomic importance of the leaf surface. In : *Current concepts in plants taxonomy*, (Ed. V. H. Heywood & D.M. Morre). Academic Press, London., Pp. 60 – 94.

Takhtajan, A.L. 1987. *Systema Magnoliophytorum*. Nauka, Leningrad. Pp. 438.

Takhtajan, A.L. 1997. *Diversity and Classification of Flowering Plants*. Columbia University Press, New York.