

MICROMORPHOLOGICAL STUDY ON THE LEAF EPIDERMIS OF *Schizostachyum nees* FROM VIETNAM

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SUMMARY

The foliage leaf epidermis of 13 *Schizostachyum* species from Vietnam was investigated by using scanning electron microscopy. The results indicated that hairs - microhairs commonly seen and consist of three types such as long hairs, geniculate hairs, and spines hairs; the stomata of all species on the lower epidermis are larger, elliptical in shape and arranged in 2 - 5 rows on each side of a vein, each stoma covers finger - like protuberances (papillae) which come forth from the epidermal cells next to the epidermal cells, incline towards the center of stoma. However, the stomata on the lower epidermis covers finger - like protuberances and hairs - microhairs between leaf blades of different species. These characters were of taxonomic significance at the specific species level.

Keywords: Hairs - microhairs, scanning electron microscopy, stomata, *Schizostachyum*.

ĐẶC ĐIỂM HÌNH THÁI TẾ BÀO BIỂU BÌ CHI NÚA Ở VIỆT NAM

Hình thái tế bào biểu bì lá của 13 loài nứa ở Việt Nam được quan sát dưới kính hiển vi điện tử quét. Kết quả cho thấy có 3 kiểu lông xuất hiện: lông dài, lông hình gồi và lông hình gai; tế bào khí khổng ở dưới mặt lá, lớn, hình ellip, xếp thành 2 - 5 hàng, mỗi tế bào khí khổng có 4 tế bào nhô ra từ tế bào biểu bì quanh khí khổng và phủ tế bào khí khổng. Tuy nhiên, tùy theo mỗi loài có kiểu lông và tế bào nhô khác nhau. Đây là những đặc điểm bổ sung quan trọng cho việc nhận biết các loài nứa ở Việt Nam.

Từ khóa: Lông - vi lông, kính hiển vi điện tử quét, khí khổng, chi nứa.

I. INTRODUCTION

The usefulness of anatomical characters of the epidermis of bamboos in classification has been recognized for a long time. Brandis (1907) studied the structure of bamboo leaves with special reference to their upper (adaxial) and lower (abaxial) epidermis. Takenouchi (1941) published detailed account of Japanese bamboos with special reference to their morphology, anatomy and development.

The shape of epidermal cells and stomata are also characteristic and can often be of value for diagnostic purposes. Pattanath and Rao (1969) evaluated the importance of anatomical features in the identification of bamboos. They clearly show that the epidermal features arrange along with internodal structure and is very useful in differentiating them. Furthermore, several authors (Wu, 1962; Yang *et al.*, 2008) have also studied the shape of stomata of *Schizostachyum* species from China. The detailed studies show that the shape of stomata on the lower epidermis covers finger-like protuberances (papillae). They come forth from the epidermal cells next to the epidermal cells and next to the guard cells. They are obvious variations in papillae forms and

distributional patterns around the stomatal apparatus amongst the examined genera and species. Their significance is indicating taxonomic value.

The aims of this investigation are to provide the basis for an authoritative description of the anatomical structure of certain, to determine the variability and possible trends the stomata on the lower epidermis covers finger-like protuberances and hairs - microhairs between leaf blades of different species, which could be used in an identification for the *Schizostachyum* species from Vietnam.

II. MATERIALS AND METHODS

The samples of this study were collected from wild populations. The origins of the material used in the present study are given in table 1. The materials for scanning electron microscopy (SEM) were submerged in xylene for at least 4 hours in order to remove the waxy covering from the leaf epidermis, and then were attached directly to Petri dish without any treatment. After gold sputtering, the specimens were examined and photographed. The terminology of epidermis appendages follows Metcalfe (1960), Wu (1962) and Yang *et al.*, (2008).

Table 1. Taxa and voucher for species sequenced in this study

Taxa	Voucher No.	Source
<i>Schizostachyum hainanense</i>	1220080467 (FSIV)	Hue, Vietnam
<i>Schizostachyum</i> sp1	1020100471 (FSIV)	Baria, Vietnam
<i>Schizostachyum pseudolima</i>	1220080465(FSIV)	Phu Tho, Vietnam
<i>Schizostachyum funghomii</i>	1220080464(FSIV)	Phu Tho Vietnam
<i>Schizostachyum nghianum</i>	1200904712(FSIV)	Tuyen Quang, Vietnam
<i>Schizostachyum aciculare</i>	0820090466(FSIV)	Phu Quoc Island, Vietnam
<i>Schizostachyum mekongense</i>	1200904714(FSIV)	Lam Dong, Vietnam
<i>Schizostachyum</i> sp2	20090470 (FSIV)	Lam Dong, Vietnam
<i>Schizostachyum</i> sp3	1520090466 (FSIV)	Hai Duong, Vietnam
<i>Schizostachyum yalyense</i>	06200504662 (FSIV)	Gia Lai, Vietnam
<i>Schizostachyum langbianense</i>	1020060460 (FSIV)	Lam Dong, Vietnam
<i>Schizostachyum ninhthuanense</i>	1512200804661 (FSIV)	Ninh Thuan, Vietnam
<i>Schizostachyum dullooa</i>	0710600 (FSIV)	Tuyen Quang, Vietnam

III. RESULTS

The foliage leaf epidermis of 13 species of *Schizostachyum* investigated (fig. 1 - 5). It seems to be made up of the forms of short cells, long cells, midrib of the leaf blade and silica bodies are more conspicuous when examined with SEM similar to the results of previous studies (Metcalf, 1956, 1960; Tateoka, 1959; Wu, 1962; Clark, Londono, 1991, Chen *et al.*, 1992). In case of the

genus *Schizostachyum*, epidermal cells are highly modified and become quite different in appearance from the original cell. These characters are important in classification such as: hairs - microhairs and palliate forms; and distributional patterns around the stomata apparatus of the abaxial and adaxial foliage leaf epidermis (Wu, 1962; Yang *et al.*, 2008). They are presented in table 2 and figure: 1 - 5.

Table 2. Characters of foliage leaf epidermis (SEM)

Name of species	Hairs				Stomata		Figure
	B	S	G	L	Rows	Papillae forms and distributional patterns around the stomatal apparatus	
<i>S. aciculare</i>			+			4, triangular, overarching and surrounded	A
<i>S. sp2</i>			+		4 - 5	4, triangular, overarching and long	H
<i>S. sp3</i>			+		4 - 5	4, triangular, overarching and long	I
<i>S. sp1</i>		+		+	2 - 4	4, triangular, overarching and long	B
<i>S. dullooa</i>		+		+	4 - 4	4, triangular, overarching and short	C
<i>S. funghomii</i>	++			+	4 - 4	4, triangular, overarching and surrounded	M
<i>S. nghianum</i>				+	4 - 4	4, triangular, overarching and surrounded	L
<i>S. hainanense</i>		++	+	+	2 - 4	4, triangular, overarching and long	K
<i>S. langbianense</i>		++	+		4 - 4	4, triangular, overarching and surrounded	E
<i>S. ninhthuanense</i>		++	+	+	4 - 5	4, triangular, overarching and surrounded	G
<i>S. pseudolima</i>	++		+		2 - 4	4, triangular, overarching and long	J
<i>S. mekongensis</i>		++	+		4 - 5	4, triangular, overarching and long	F
<i>S. yalyense</i>		+	++	++	4 - 5	4, triangular, overarching and surrounded	D

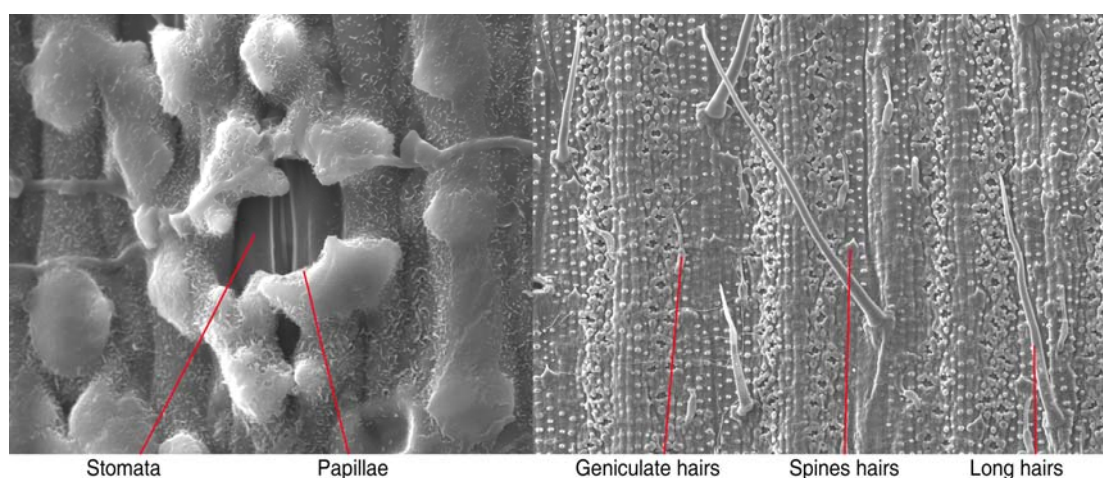


Fig.1. Micromorphology of abaxial epidermis

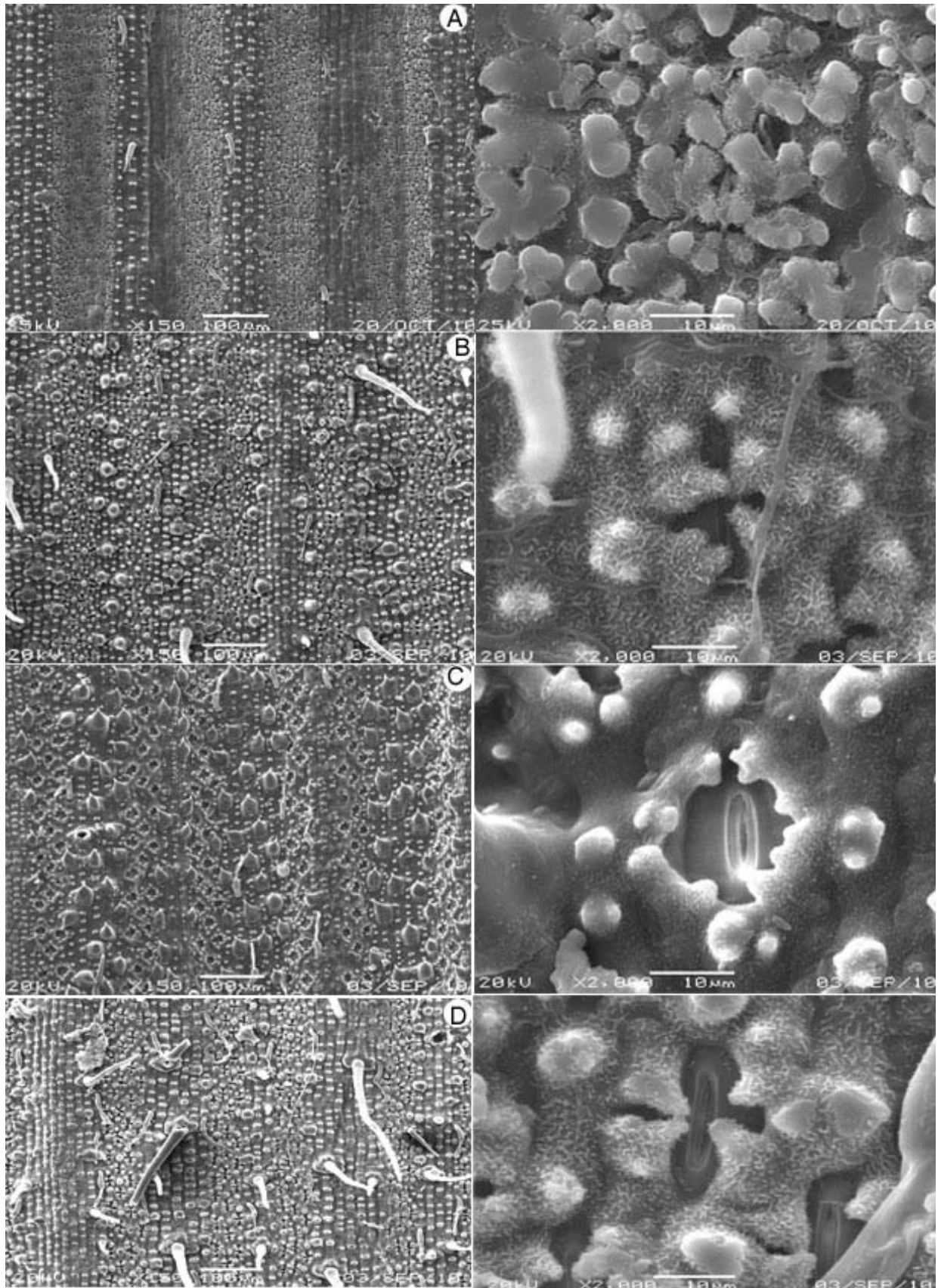


Fig. 2. Micromorphology of papillae on abaxial leaf epidermis (scanning electron microscopy).
A. *S. aciculare*; **B.** *S. sp1*; **C.** *S. dullooa*; **D.** *S. yalyense*

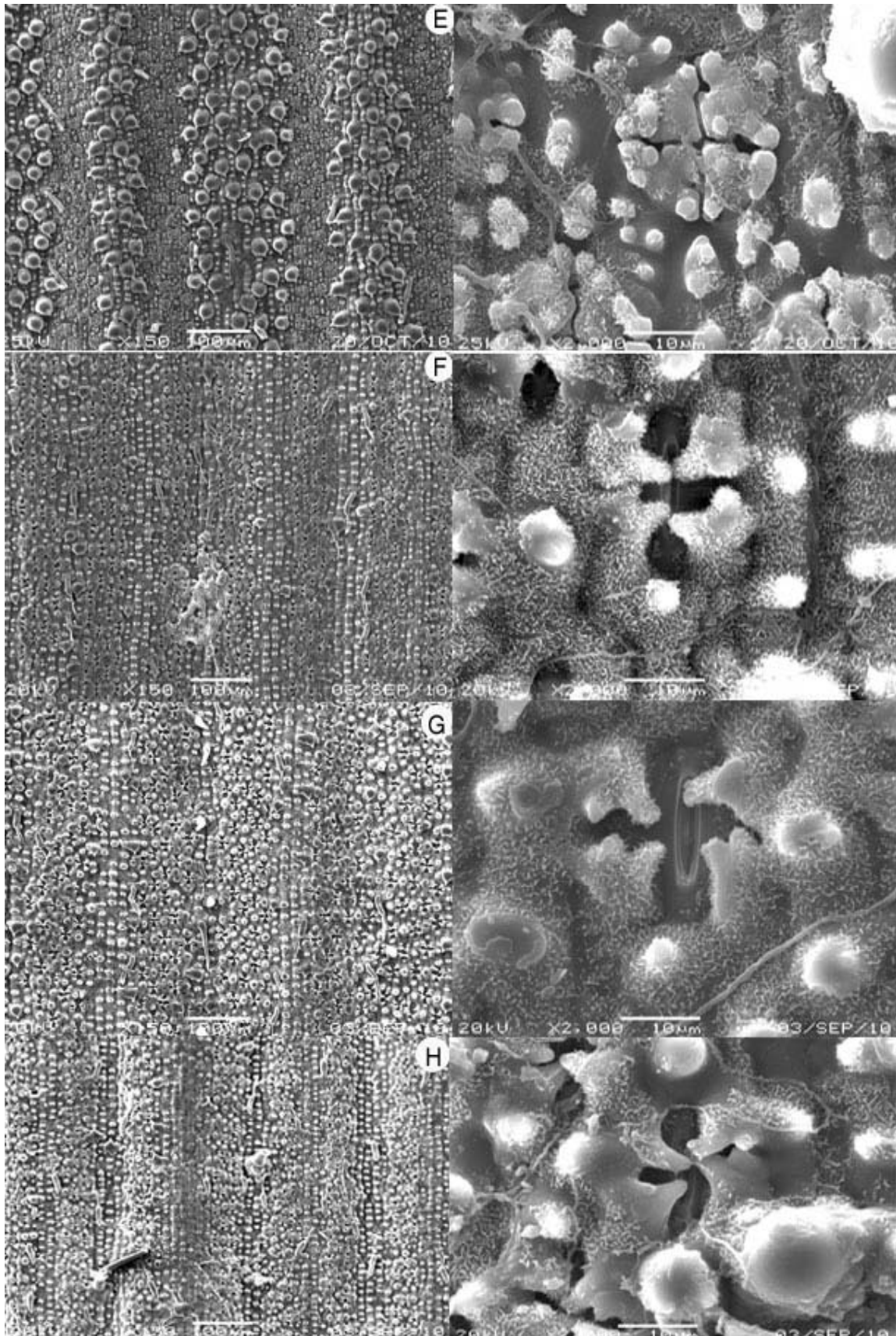


Fig. 3. Micromorphology of papillae on abaxial leaf epidermis (SEM). **E.** *S. langbianense*; **F.** *S. mekongense*; **G.** *S. ninhthuanense*; **H.** *S. sp2*.

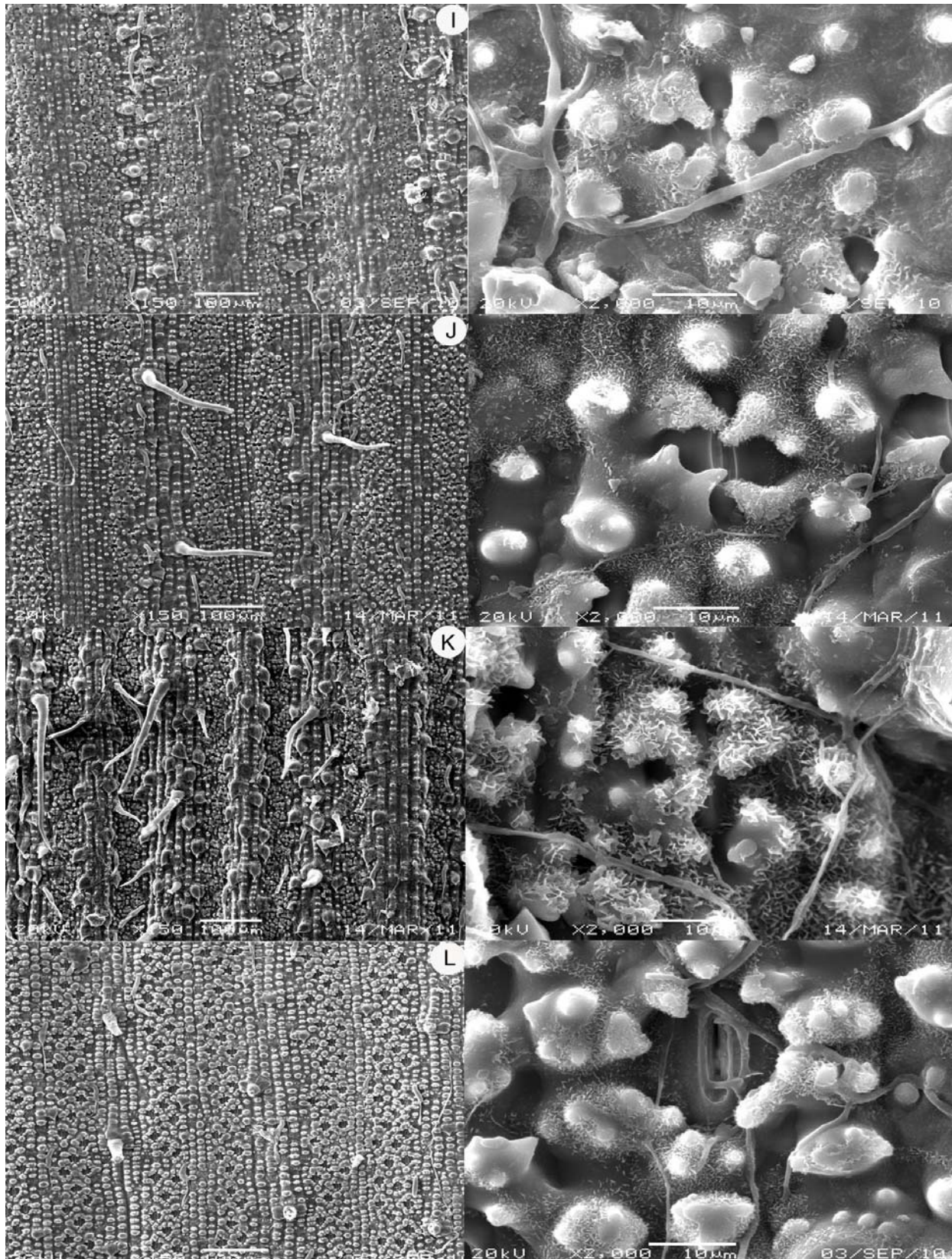


Fig. 4. Micromorphology of papillae on abaxial leaf epidermis (SEM).
I. *S. sp3*; **J.** *S. pseudolima*; **K.** *S. hainanense*; **L.** *S. nghianum*

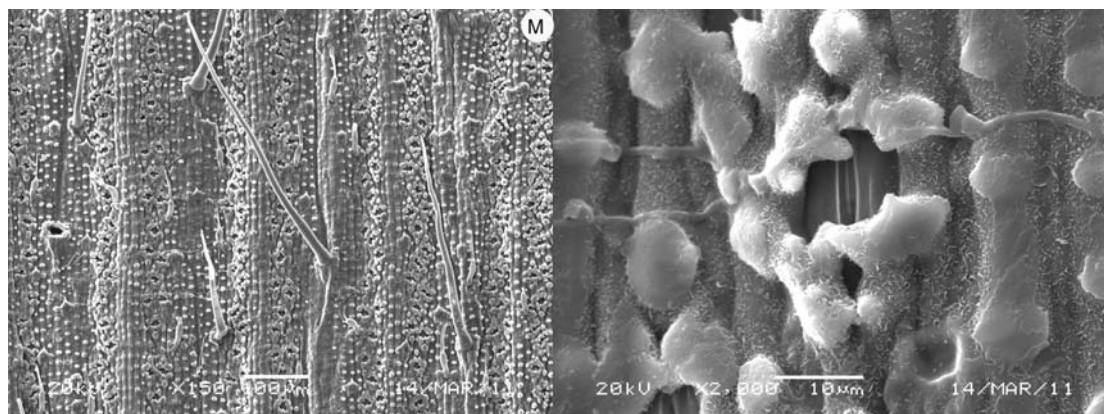


Fig. 5. Micromorphology of papillae on abaxial leaf epidermis (SEM). **M.** *S. funghomii*.

3.1. Hairs - Microhairs

Hairs - Microhairs commonly seen and consist of three types such as long hairs, geniculate hairs, and spines:

3.1.1. Long hairs (L)

Long hairs are narrow, long and one celled hairs. They are usually found on the epidermis covers but widely distributed over the completely lower epidermis of some species (*S. funghomii*, *S. nghianum*, *S. hainanense*, *C. langbianense*, *S. ninhthuanense* and *S. yalyense*). However, long hairs are abundant in *S. yalyense*.

3.1.2. Geniculate hairs (G) (bicellular hairs)

Geniculate hairs arise from the derivatives of the short epidermal cells (Wu, 1962), which are usually broken off by external forces and distributed on the lower epidermis covering the sclerenchyma region. They situated on the lower epidermis of some species (*S. sp2*, *S. sp3*, *S. hainanense*, *S. langbianense*, *S. ninhthuanense*, *S. pseudolima*, *s. mekongense* and *S. yalyense*). However, long hairs are abundant in *S. yalyense*.

3.1.3. Spines hairs (S)

Spines hairs are short, spine - like cells, which are rounded at the base and acute at the apex (Wu, 1962). They are usually dense present

on both surfaces over sclerenchyma region in some species (*S. hainanense*, *S. langbianense*, *S. ninhthuanense*, *S. mekongense*), but sparse in *S. yalyense*, *S. funghomii* and *S. pseudolima*.

3.2. The stomata and papillae

The stomata of all species on the lower epidermis are larger, elliptical in shape and arranged in 2 - 5 rows on each side of a vein. Each stoma covers finger - like protuberances (papillae) which come forth from the epidermal cells next to the epidermal cells, incline towards the center of stoma (Wu, 1962). There are obvious variations in papillae forms and distributional patterns around the stomatal apparatus amongst the examined genera, and their significance is to indicate taxonomic value (Wu, 1962; Yang *et al.*, 2008). There are usually four triangular papillae overarching each individual stomata apparatus in all species, but otherwise, *S. langbianense*, *S. aciculare*, characterized by having four triangular papillae overarching each individual stomata apparatus and surrounded. However, four triangular papillae overarching each individual stomata apparatus are unequal in length amongst species. There are two types:

- The triangular papillae overarching are surrounded, which found in *S. dullooa*, *S. nghianum*, *S. ninhthuanense* and *S. yalyense*;

- The triangular papillae overarching are long, which found in some other species.

In addition to the papillae, the number of rows of stomata is also worth noting (Wu, 1962). On the lower epidermis in *Schizostachyum*, the number of rows of stoma varies from 2 to 5 rows on each side of a vein and depends on the species. The number rows of stoma can be divided into 4 patterns:

In some case, there are 4 - 5 rows found in *S. yalyense* and *S. ninhthuanense*.

In some case, there are 4 - 5 rows found in *S. sp2*, *S. sp3* and *S. mekongense*.

In some case, there are 3 - 4 rows found in *S. funghomii*, *S. sp2* and *S. langbianense*.

In some case there are 2 - 3 rows found in *S. hainanense*, *S. pseudolima*.

3.3. Discussion and conclusion

Wu (1962) shown about the variation in occurrence and distribution of microhairs. It is important to know whether the walls of the basal cells of microhairs are smooth. The leaf epidermal characters of *Schizostachyum* species in general, and the papillae form and distributional pattern on the adaxial foliage leaf epidermis have been proven to be of

taxonomic value at the specific, generic (Metcalf, 1960, Yang *et al.*, 2008). In the current study, epidermal features were again constant within species. *Schizostachyum* species were confirmed that each individual stomatal apparatus is overarched by four branched of unbranched triangular papillae (Yang *et al.*, 2008). However, four triangular papillae overarching each individual stomata apparatus are unequal in length amongst species, as discussed above.

These are important in classification such as hairs - microhairs and palliate forms and distributional patterns around the stomata of the abaxial foliage leaf epidermis. Thus, with the possible combination of several vegetative and anatomical characteristics, an experienced anatomist could succeed in identifying the species of *Schizostachyum*.

Acknowledgements

The authors would like to express their sincere thanks to Vietnamese Academy of Forest Science and Foundation of China (grant no. 30770155), South China Botanical Garden for supporting collected specimens and the investigating scanning electron microscopy.

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Người thẩm định: TS. Phí Hồng Hải