Steciana

2017, Vol. 21(2): 41–48
doi:10.12657/steciana.021.005

www.up.poznan.pl/steciana

ISSN 1689-653X

MICROMORPHOLOGY OF STAMENS OF SOME SPECIES OF THE GENUS *SANSEVIERIA* PETAGNA (ASPARAGACEAE)

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(Received: February 25, 2017. Accepted: March 20, 2017)

Abstract. The paper presents in the first time the results of a micromorphological study on stamens of *Sansevieria* species. Flowers of 15 species obtained from herbarium specimens deposited at the Royal Botanic Gardens, Kew, the Botanical Garden Berlin-Dahlem and the Botanical Garden in Poznań were studied. Observations were conducted under a light and a scanning electron microscope. The study revealed significant differences between the outer and inner surfaces of anthers. All species have a well-defined endothecium of enlarged cells with a U-shaped or helical secondary wall thickening. The article includes descriptions and illustrations of several quantitative and qualitative features of anthers and filaments of some *Sansevieria* species. Our study indicates that stamen micromorphology may be taxonomically significant.

Key words: *Sansevieria,* anther, endothecium, filament, micromorphology, SEM, LM, taxonomy

INTRODUCTION

Sansevieria comprises ca. 60 species worldwide, mainly in dry or arid areas of the Old World tropics and subtropics (Brown 1915, Bos 1998, Staples & Herbst 2005, Mabberley 2008). Africa is the center of diversity for *Sansevieria* (Brown 1915, Morgenstern 1979, Mabberley 2008) with some species distributed in the Arabian Peninsula, South Asia and Southeast Asia (Brown 1915, Morgenstern 1979). Plants are usually xerophytic perennials, often rhizomatous, and they may be herbs, shrubs or trees (Staples & Herbst 2005). Some species are of medicinal and horticultural value (Chahinian 1985, Neuwinger 1986, Bos 1998, Staples & Herbst 2005). Based on the mode of anther dehiscence four types may be distinguished, i.e. longitudinal, transverse, poricidal and valvular. The longitudinal type is further divided into extrorse, introrse and latrorse subtypes (Radford et al. 1974, Bano et al. 2008). Very few reports are available on anthers of monocots (Buchmann 1983, Endress 1996, Bano et al. 2008). The value of the endothecium in taxonomy was investigated by Dormer (1962) and Nordenstam (1978) with reference to the Asteraceae, by Arora & Tiagi (1977) in the Apiaceae, by Eyde (1977) in the Onagraceae, by Manning & Goldblat (1990) in the Iridaceae and Noel (1983) in various species.

The present study was carried out to provide information on anther types of *Sansevieria* species based on their mode of dehiscence, microornamentation of anthers and filaments.

MATERIAL AND METHOD

The studied flowers of 15 *Sansevieria* species were obtained from herbarium specimens deposited at the Royal Botanic Gardens, Kew (K), the Botanical Garden Berlin-Dahlem (B) and the Botanical Garden in Poznań (BG AMU). A list of the analysed taxa, with their affiliation to sections and subsections, is given in Table 1. A total of 10 stamens per specimen were used for these measurements. The stamens were examined using a light microcope (LM) and a scanning electron microscope (SEM). For the LM observations (anther length and endothecial wall thickening) the

Table 1. A list of the analysed species

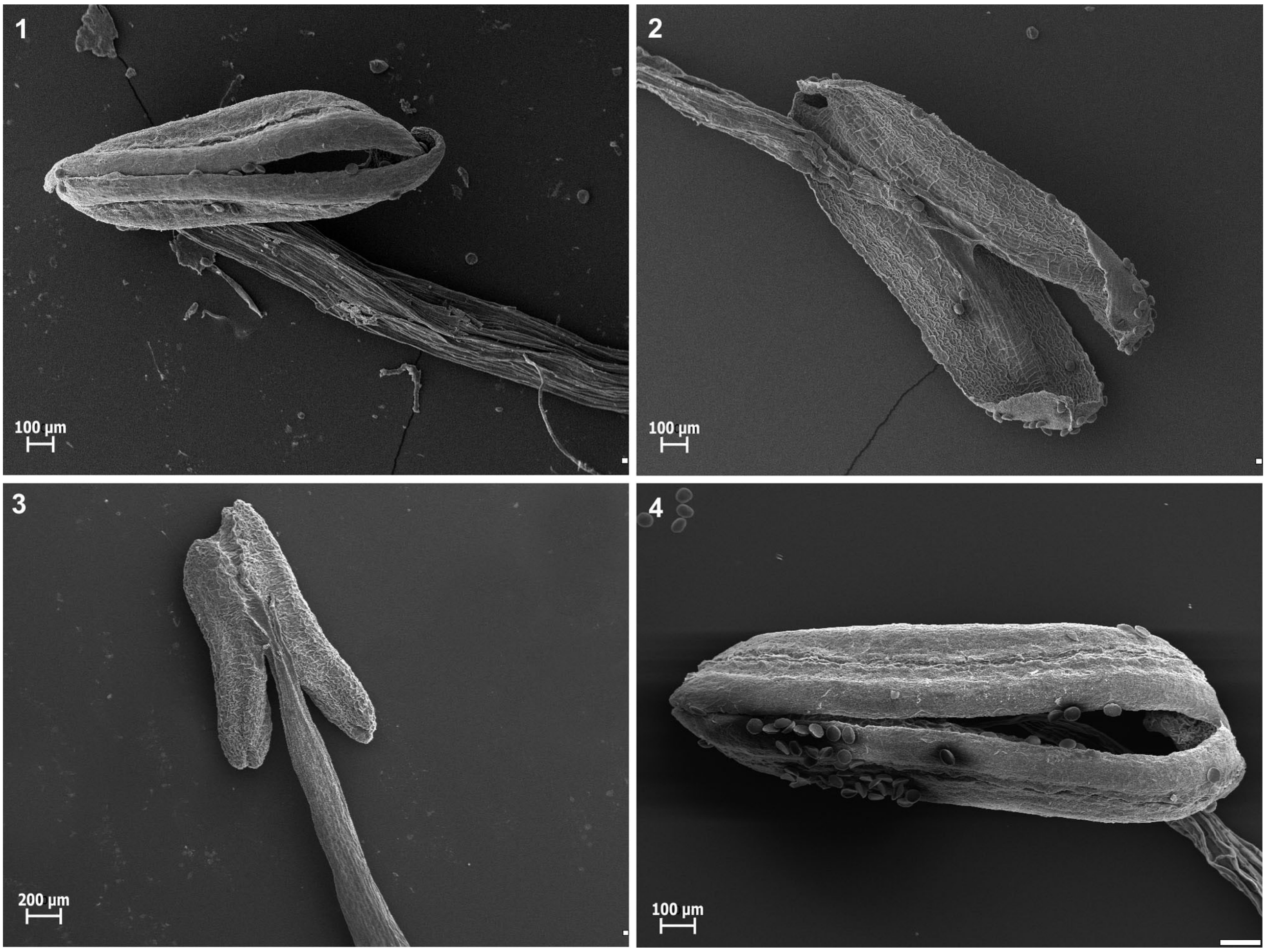
Section	Subsection	Species	Country of origin	Voucher
Sansevieria	Sansevieria	*S. *hyacinthoides* (L.) Druce	South Africa	Schlieben 10570 (K)
Sansevieria	Sansevieria	*S. parva* N.E. Br.	East Africa unknown	cult., Kew, Pfenning 1034 (K) cult. BG AMU, I_I001_004_0000_6977_1231
Sansevieria	Sansevieria	*S. parva* N.E. Br. (*dooneri)*	Kenya	cult. Kew, Brandham & Cutler 01929
Sansevieria	Sansevieria	*S. trifasciata* Prain	Cameroon	Lowe 3035 (K)
Sansevieria	Sansevieria	*S. roxburghiana* Schult. & Schult.	unknown	cult. Kew, Marchward 631310
Sansevieria	Hastifolia	*S. *cylindrica* Bojer ex Hook	Angola	s. coll. s. n. (K) K000204052
Sansevieria	Hastifolia	*S. pearsonii* N.E. Br.	Zambia	Fanshawe 6946 (K)
Sansevieria	Stolonifera	*S. *suffruticosa* N.E. Br.	Kenya	Tweedie 3666 (K)
Dracomima		*S. arborescens* Cornu Gérôme et Labroy	Tanzania	Faulkner 1827 (K)
Dracomima		*S. bagamoyensis* N.E. Br.	Tanzania	Bally 13309 (B)
Dracomima		*S. *ehrenbergii* Schweinf. ex Baker	Kenya	Hensley 1256 (K)
Dracomima		*S. perrotii* Warb. (*S. robusta* N.E. Br.)	Kenya	Pfenning, Herford Pf 1023 S(B)
Dracomima		*S. powellii* N.E Br.	Kenya	Rauh Ke 875 (B)
Cephalantha		*S. *kirkii* Baker	Tanzania	Faulkner 1989 (K)
Cephalantha		*S. sambiranensis* Perrier	Madagascar	Phillipson 2023 (K)

*Type species for the section or subsection.

anthers were boiled in water. The SEM observations (anther shape, outher and inner surface of anthers, as well as surface of filament) were made on air-dried anthers and filaments. Anther length was measured under a Brinella microscope, endothecium cells were observed using an Olympus microscope model BX 40 equipped with a camera. For the anther length the minimal and maximal values of characteristics as well as arithmetical means and the coefficient of variability were calculated. Micrographs were taken with a SEM type EVO 40 microscope (Carl Zeiss, Jena, Germany) at an accelerating voltage of 15 kV, at the Confocal and Electron Microscopy Laboratory, the Faculty of Biology, the Adam Mickiewicz University, Poznań, Poland. Prior to observations the prepared material was sputtered with gold using an SCB 050 ion sputter. The study was documented with photographs taken during observations, primarily at a magnification ranging from ×100 to ×200 for anther shape and ×2500 for the epidermal sculpture of anthers and filaments. SEM micrographs were used mainly to investigate the overall shape, type of sculpturing, and to obtain more detailed information on the sculpturing. Micromorphological features of anthers were observed in their outer and inner surfaces. The terminology of epicuticular waxes was applied following Barthlott (1981).

RESULT AND DISCUSSION

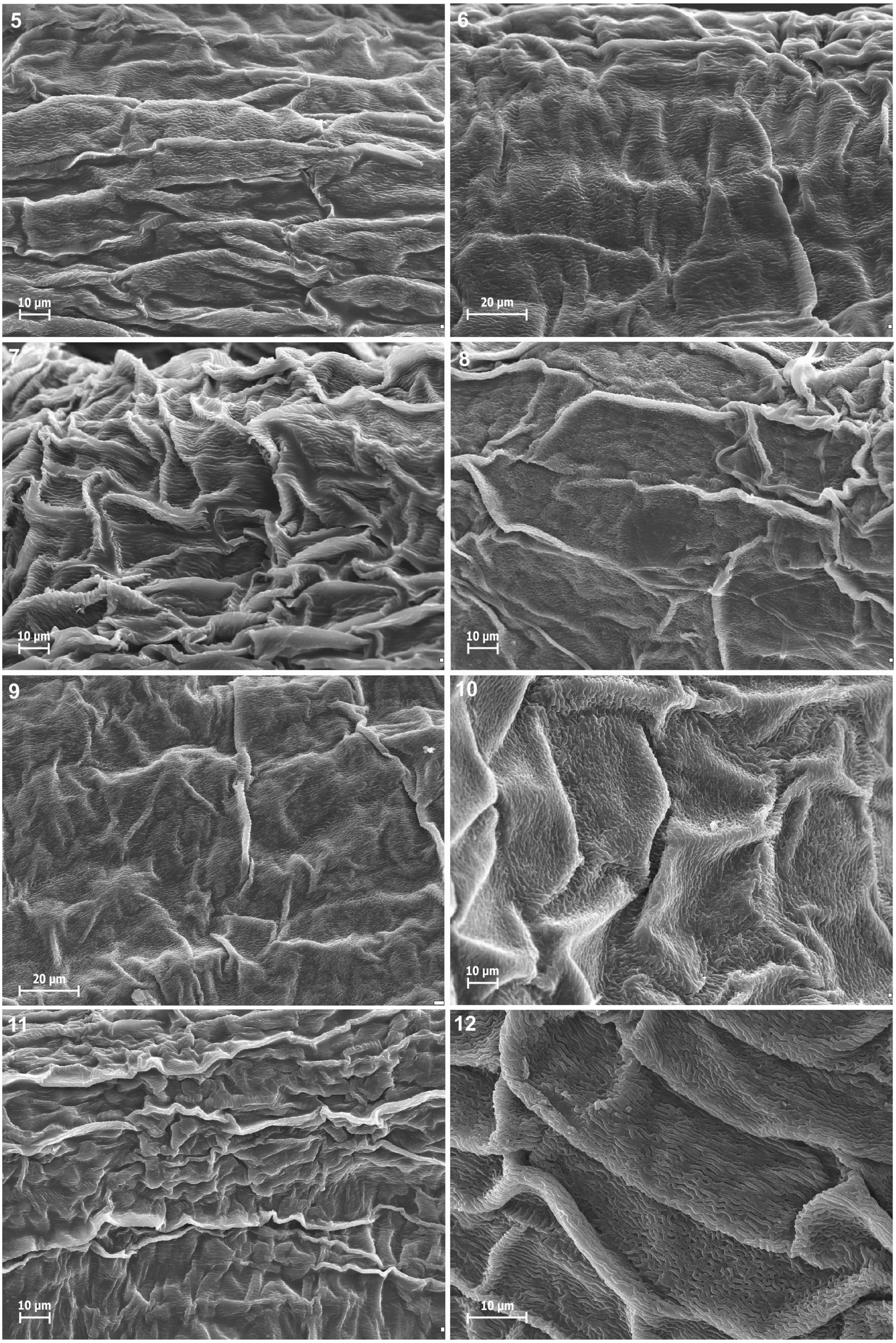
Generally anthers were dorsifixed, elongate-elliptic, dehiscing via longitudinal slits, latrorse. The shape of anthers show low variability (Figs 1–4). This type of anthers was reported in the families Asparagaceae, Cyperaceae, Juncaceae and Potamogetonaceae (Bano et al. 2008). Buchmann (1983) also observed some monocot families with at least one taxon, in which anthers dehisce by pores or apical slits. Anther length ranged from 1.25 (*S. kirkii, S. roxburghiana* and *S. sambiranensis*) to 1.98 mm (*S. hyacinthoides* and *S. pearsonii*). The average length ranged from 1.28 to 1.77 mm. Coefficients of variability ranged from 2.6 (*S. parva*) to 18.4 (*S. pearsonii*) (Table 2). SEM investigation at the higher magnification of outer surface of anthers revealed one type of anther sculpture–reticulate in all studied species (Figs 5–16). The cell shapes were polygonal, irregular elongate in one direction. The anticlinal walls which formed a boundary between the epidermal cells were depressed below the outer tangential surfaces cells (Figs 5–16). The periclinal cell walls of the species were flat (Figs 5, 8–10, 12, 14), or convex (Figs 13, 16). The cuticle ornamentation on the outher surface of anthers (Table 2) was rugulate-perforate (Figs 5, 6, 8, 10, 14), rugulate (Figs 11, 13), striate (Fig. 7), striate-perforate (Fig. 9), striate-rugulate (Fig. 12) and granulate-rugulate (Figs 15, 16). There were significant differences between outer and inner surface of anthers in all studied species. The epidermal cells in SEM of the inner surface of anther show that the surface was covered by orbicule (Figs 17, 18). The endothecium cells may be more or less isodiametric, broadly fusiform or elongated and arranged paralleled. The orientation is usually related in a specific way to the long axis of the anther. All species have a well-defined endothecium of enlarged cells with a U-shaped or helical secondary wall thickening and there was a considerable range in cell size (Figs 19–26). Our results are in agreement with the results obtained by the others authors Untawale & Bhasin (1973), French (1985, 1986), Manning & Goldblat (1990). The filament in all species was filiform (Figs 1–4). The surface



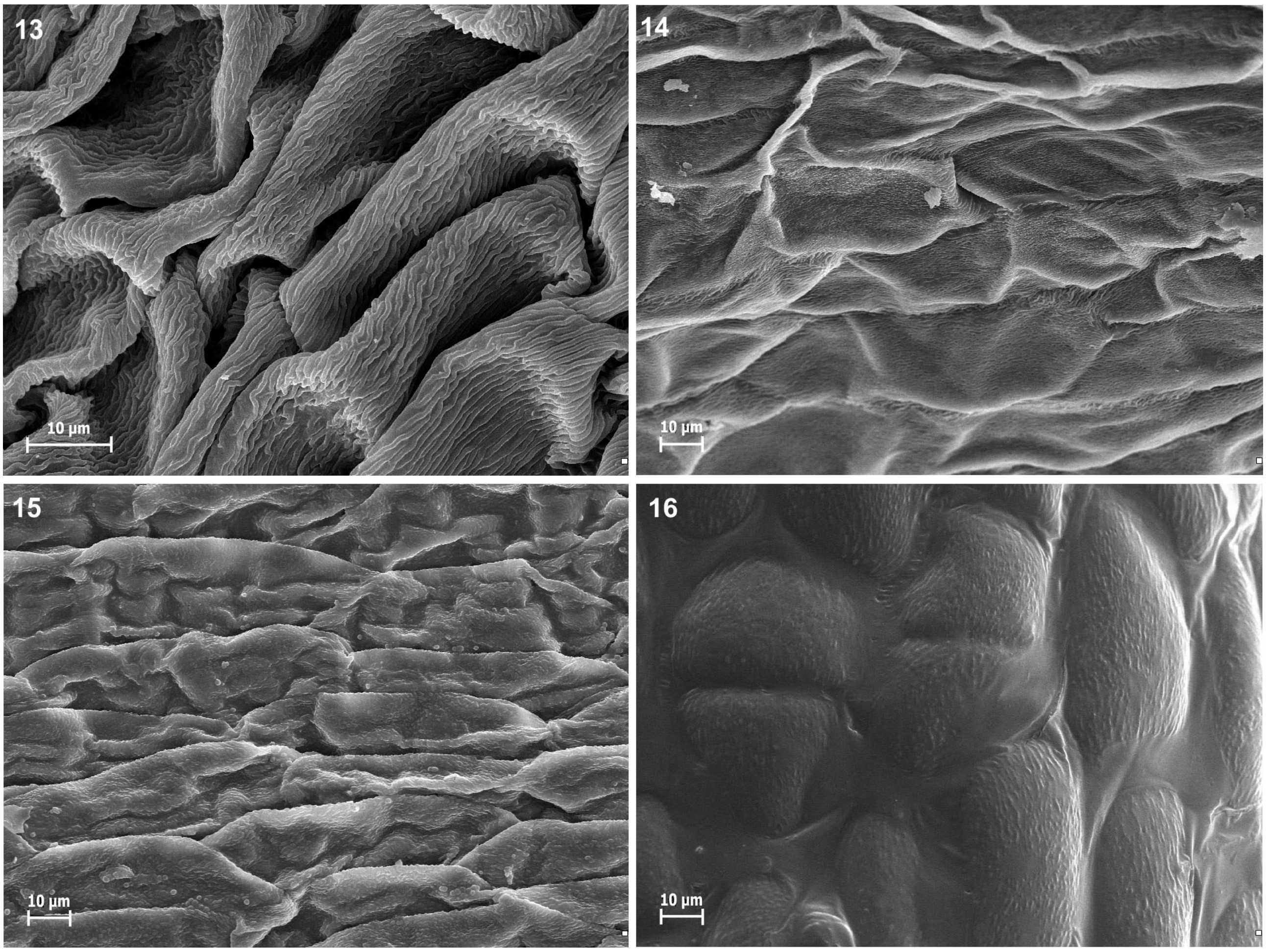
Figs 1–4. SEM micrographs of stamens of *Sansevieria*: (1) *S. bagamoyensis,* (2) *S. powelii,* (3) *S. suffruticosa,* (4) *S. trifasciata*

Table 2. Quantitative and qualitative features of studied traits of stamens for the *Sansevieria* species analysed in the study

Species	Length of anther (mm)				Ornamentation	
	min.	max.	mean (±SD)	cv	cuticle on the outer surface of anther	surface of filament
Sansevieria arborescens	1.51	1.72	1.62(0.07)	4.8	rugulate, perforate	thin striate
S. bagamoyensis	1.60	1.76	1.65(0.06)	3.9	rugulate	striate
S. cylindrica	1.45	1.87	1.69(0.17)	9.9	rugulate, perforate	rugulate-striate
S. dooneri	1.48	1.95	1.66(0.17)	10.5	striate	smooth
S. ehrenbergii	1.38	1.52	1.42(0.06)	4.3	rugulate, perforate	striate
S. hyacinthoides	1.48	1.98	1.75(0.18)	10.7	rugulate, perforate	striate
S. kirkii	1.25	1.87	1.52(0.28)	17.9	slightly striate, perforate	smooth-rugulate
S. parva	1.29	1.38	1.35((0.04)	2.6	rugulate, perforate	striate
S. pearsonii	1.29	1.98	1.56(0.28)	18.4	rugulate	smooth-rugulate
S. perrotii	1.32	1.60	1.45(0.11)	7.4	rugulate	striate
S. powelii	1.36	1.51	1.41(0.06)	6.2	striate-rugulate	striate
S. roxburghiana	1.25	1.67	1.46(0.20)	13.7	rugulate, perforate	striate
S. sambiranensis	1.25	1.38	1.28(0.05)	4.4	rugulate-granulate	rugulate-granulate, perforate
S. suffruticosa	1.45	1.79	1.57(0.13)	8.4	rugulate	striate
S. trifasciata	1.61	1.93	1.77(0.16)	9.3	granulate-rugulate	thin striate-rugulate

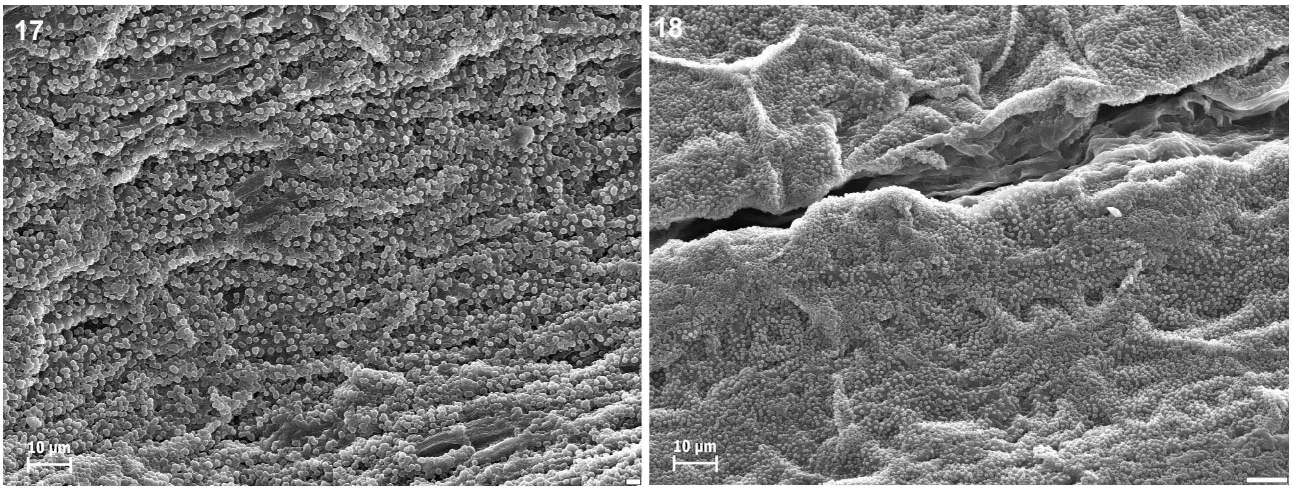


Figs 5–12. SEM. Outer surface of anther of *Sansevieria*: (5) *S. arborescens*, (6) *S. cylindrica*, (7) *S. dooneri*, (8) *S. hyacinthoides*, (9) *S. kirkii*, (10) *S. parva*, (11) *S. pearsonii*, (12) *S. powelii*

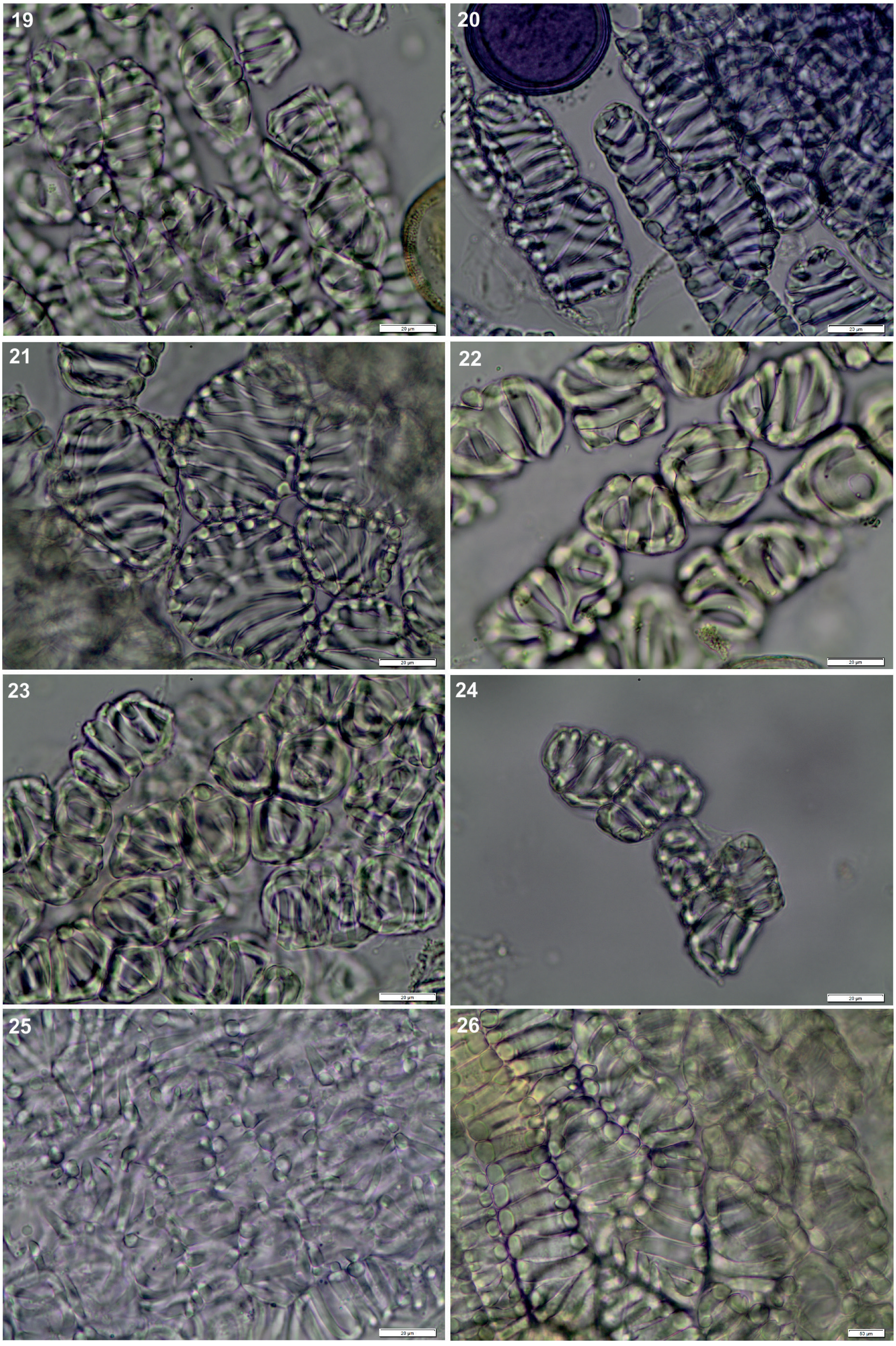


Figs 13–16. SEM. Outer surface of anther of *Sansevieria:* (13) *S. perrotii,* (14) *S. roxburghiana,* (15) *S. sambiranensis,* (16) *S. trifasciata*

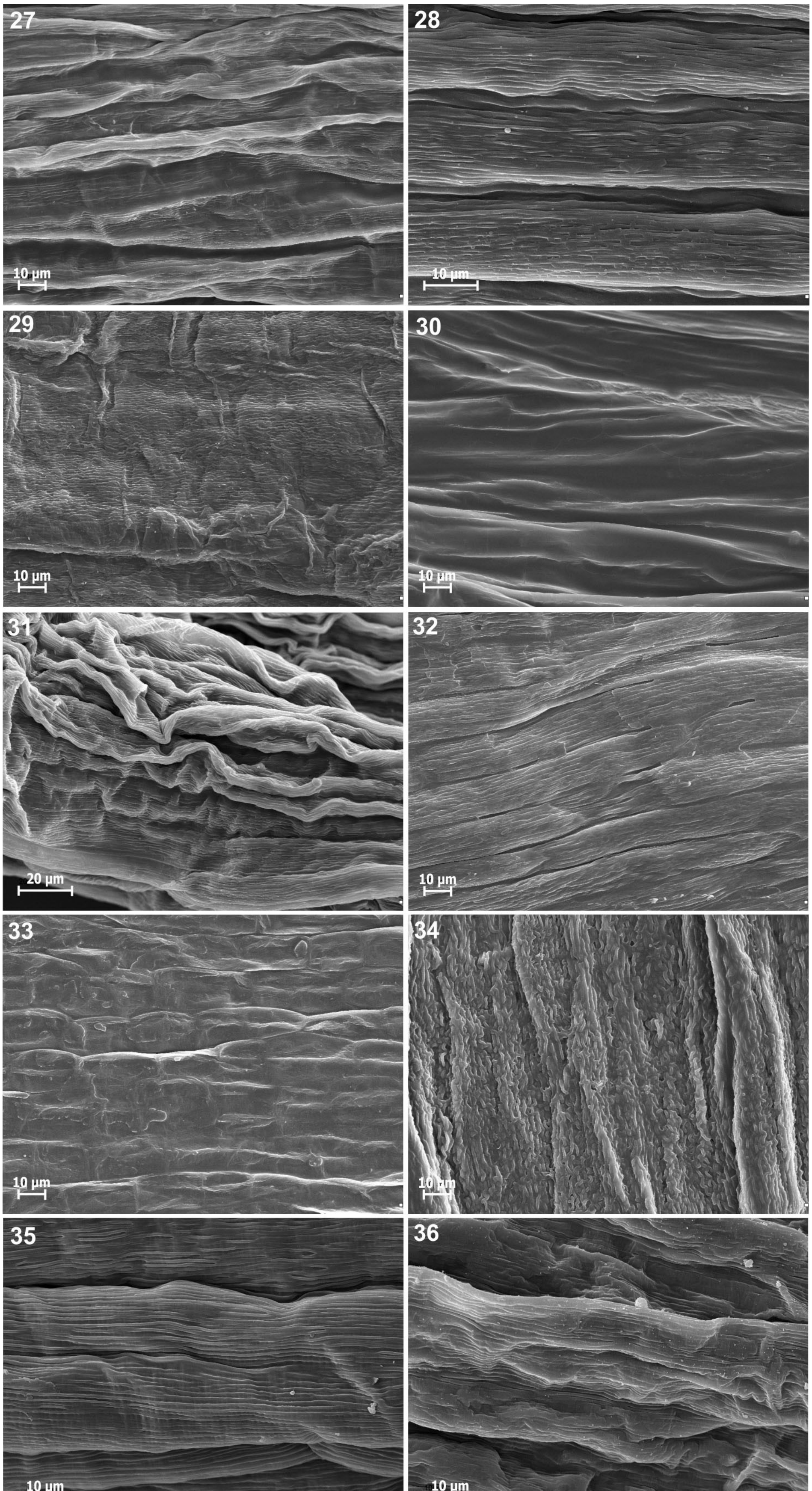
of filament varied from (Table 2) smooth (Fig. 30), smooth-rugulate (Fig. 33), rugulate-striate (Fig. 29), striate (Figs 27, 28, 31, 32, 35, 36) to rugulate-granulate-perforate (Fig. 34). To date *S. dooneri* has been treated as a synonym of *S. parva* (Mansfeld 2015). Both species have soft, flat leaves without wall bands for water storage (Koller & Rost 1988) and without cuticular rims around stomata (Klimko et al. unpublished results). Both species differ in the epidermal microornamentation of staminal filaments. Ornamentation of filaments in *S. dooneri* was smooth (Fig. 30) and in *S. parva* it was striate (Fig. 33, Table 2). The present study is the first to investigate the anther and filament surface of *Sansevieria* and detailed



Figs 17–18. SEM. Inner surface of anther of *Sansevieria*: (17) *S. hyacinthoides,* (18) *S. trifasciata*



Figs 19–26. LM. Endothecial wall thickening of *Sansevieria*: (19) *S. arborescens*, (20) *S. bagamoyensis*, (21) *S. cylindrica*, (22) *S. hyacinthoides*, (23) *S. kirkii*, (24) *S. pearsonii*, (25) *S. sambiranensis*, (26) *S. trifasciata*



Figs 27–36. SEM. Surface of filament of *Sansevieria*: (27) *S. arborescens*, (28) *S. bagamoyensis*, (29) *S. cylindrica*, (30) *S. dooneri*, (31) *S. hyacinthoides*, (32) *S. parva*, (33) *S. pearsonii*, (34) *S. sambiranensis*, (35) *S. perrotii*, (36) *S. powelii*

observations provided new data. We conclude that *S. dooneri* and *S. parva* are not one species, but should be divided into two lowest taxa in the rank of varieties (*S. parva* var. *dooneri* and var. *parva)*.

ACKNOWLEDGEMENTS

We would like to express our gratitude to Wojciech Klimko for his assistance with computer recording. The authors would like to thank two anonymous reviewers for their suggestions and comments on an earlier version of the manuscript. This work was carried out with the financial support from the National Science Center (grant no. N N303 807540), and the Department of Botany, the Poznań University of Life Sciences and the Faculty of Biology, the Adam Mickiewicz University in Poznań.

REFERENCES

Arora K., Tiagi B. (1977): The role of the endothecium in the identification of Umbellifers. Current Science 46: 531.

Bano R., Abid R., Qaiser M. (2008): Anther types of the monocot within flora of Karachi, Pakistan. Pakistan Journal of Botany 40(5): 1839–1849.

Barthlott W. (1981): Epidermal and seed surface characters of plants: Systematic applicability and some evolutionary aspects. Nordic Journal of Botany 1: 345–355.

Bos J.J. (1998): Draceanaceae. In: K. Kubitzki (ed.). The families and genera of vascular plants 3. Monocotyledons, Lilianae (except Orchidaceae). Springer-Verlag, Heidelberg, New York.

Brown N.E. (1915): *Sansevieria*. A monograph of all the known species. Bulletin of Miscellaneous Information (Royal Botanical Gardens, Kew) 5: 185–261.

Buchmann S.L. (1983): Buzz pollination in Angiosperms. In: C.E. Jones, R.J. Little (eds). Handbook of experimental pollination biology. Scientific Academic Editions, New York: 73–113.

Chahinian B.J. (1985): The *Sansevieria trifasciata* dwarf cultivars: a beginning with no end. Cactacae Succulent Journal (Los Angeles) 57: 199–203.

Dormer K.J. (1962): The fibrous layer in the anthers of Compositae. New Phytologist 61: 150–153.

Endress P.K. (1996): Diversity and evolutionary trends in angiosperm anthers. In: W.G. D'Arey, R.C. Keating (eds). The Anther (Form, function and phylogeny). Cambridge University Press, Cambridge.

Eyde R.H. (1977): Reproductive structures and evolution in *Ludwigia* (Onagraceae). 1. Androecium placentation, merism. Annals of the Missouri Botanical Garden 64: 644-655.

French J.C. (1985): Patterns of endothecial wall thickenings in Araceae: subfamilies Pothoideae and Monsteroideae. American Journal of Botany 72(3): 472-486.

French J.C. (1986): Patterns of endothecial wall thickenings in Araceae: subfamilies Colocasioideae, Aroideae and Pistioideae. Botanical Gazzete 47(2): 166-179.

Koller A., Rost T. (1988): Leaf anatomy in S*ansevieria* (Agavaceae). American Journal of Botany 75: 615–633.

Mabberley D.J. (2008): Mabberley's plant book. Cambridge University Press, Cambridge.

Manning J.C., Goldblat P. (1990): Endothecium in Iridaceae and its systematic implications. American Journal of Botany 17(4): 527–530.

Mansfeld P. (2015): Die Systematik der Gattung *Sansevieria* (Asparagaceae) – ein aktueller Stand. *Sansevieria Online* 3/1: 20–29.

Morgenstern K.D. (1979): *Sansevierias* in pictures and words. Illertalen Offsetdruck and Verlag GMBH, Kempten, Germany.

Neuwinger H. (1986): African ethnobotany; poisons and drugs: chemistry, pharmacology, toxicology. Chapman Hall, Weinheim.

Noel A.R.A. (1983): The endothecium – a neglected criterion in taxonomy and phylogeny? Bothalia 14(3, 4): 833–838.

Nordenstam B. (1978): Taxonomic studies in the tribe Senecioneae (Compositae). Opera Botanica 44: 3–83.

Radford A.E., Dickison W.C., Massey J.R., Ritchi Bell C. (1974): Vascular Plant Systematics. Harper & Row Publisher, New York.

Staples G.W., Herbst D.R. (2005): A tropical garden flora. Bishop Museum Press, Honolulu, Hawaii, USA.

Untawale A.G., Bhasin R.K. (1973): On endothecial thickenings in some monocotyledonous families. Current Science 42: 398–400.