

Akemi DOI* : Pollen morphology of four East Asian species of *Forsythia* (Oleaceae)

土井明美* : 東アジアのレンギョウ属 4 種の花粉形態

Forsythia, a genus with six species, is a deciduous tree and confined to temperate areas in Asia and Europe. *Forsythia* pollen have been only briefly characterized by light microscope (LM) observation (WODEHOUSE, 1935; ERDTMAN, 1952; etc.). Our present knowledge of pollen morphology among East Asian species of *Forsythia* is scant. Here we report LM and SEM observations of pollen from four species with one variety: *F. suspensa* (THUNB.) VAHL, *F. japonica* MAKINO, *F. japonica* var. *subintegra* HARA, *F. viridissima* LINDL., and *F. koreana* (REHDER) NAKAI. These species are distributed in Japan, Korea, and China.

Materials and methods

Most pollen was obtained from living specimen trees cultivated at the Botanical Garden of Osaka City University (KBG), in Kisaichi, Katano, Osaka Prefecture. Voucher specimens of the dried leaves and pollen are deposited in the Laboratory of Plant Taxonomy and Palaeobotany, Faculty of Science, Osaka City University (OSCU). For LM, the pollen was acetolysed according to ERDTMAN (1960) and mounted in glycerol-jelly. The dimensions given here are based on measurements of 70 grains. The slides are housed at OSCU for permanent reference. For SEM, acetolysed pollen was fixed to stubs, coated with gold and examined with an Akashi Beam Technology microscope (ALPHA-25A). The morphological terminology of REITSMA (1970) and MOORE *et al.* (1978) has been followed. The specimens examined and their provenance are as follows:

Forsythia suspensa (THUNB.) VAHL: KBG (cultivated), Katano, Osaka Pref., Japan, Akemi DOI, Apr. 3, 1993, OSCU (93A27); KBG (cultivated), Katano, Osaka Pref., Japan, Akemi DOI, Apr. 15, 1993, OSCU (93A96).

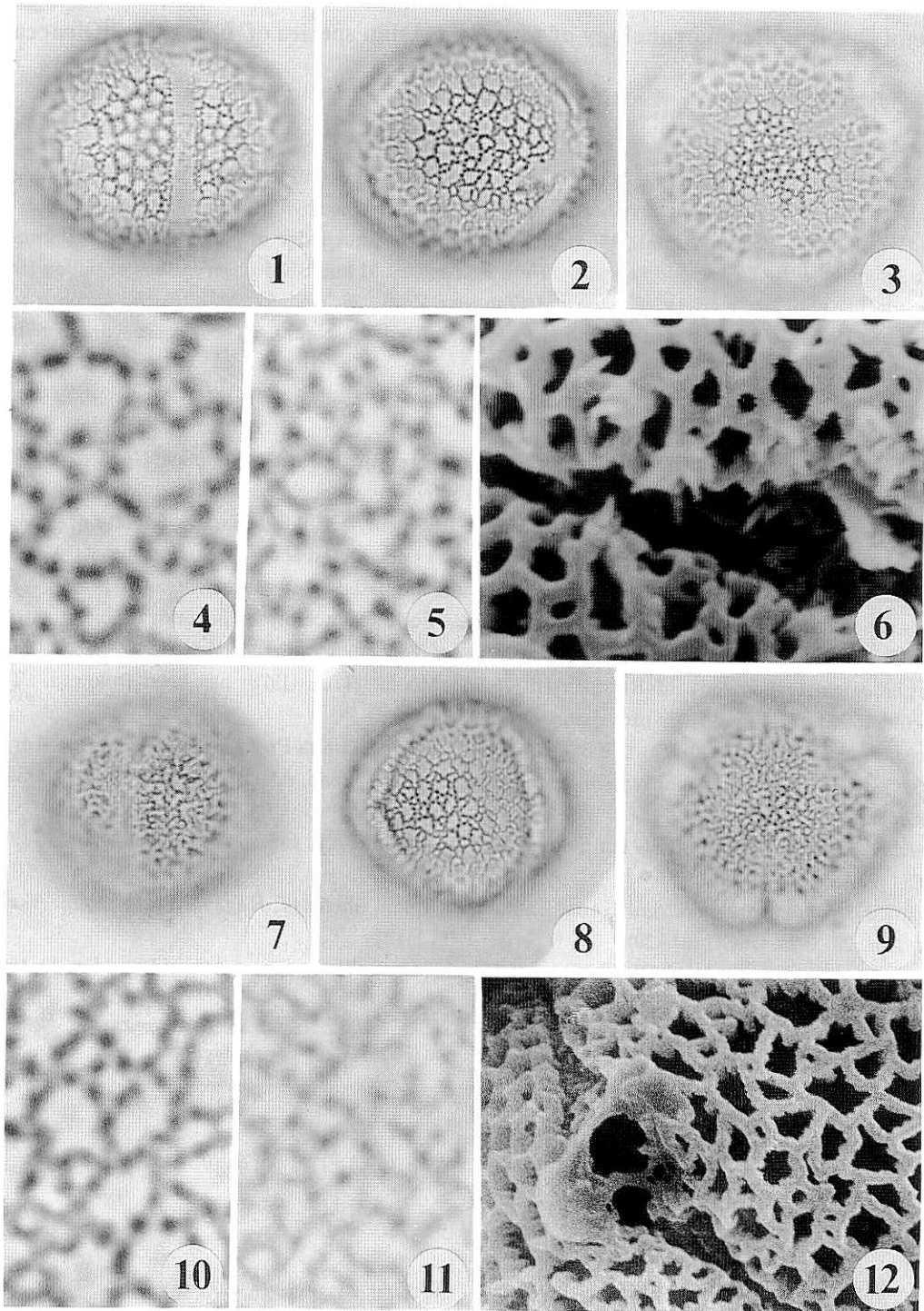
Forsythia japonica MAKINO: KBG (cultivated), Katano, Osaka Pref., Japan, Akemi DOI, Mar. 29, 1993, OSCU (93A2).

Forsythia japonica var. *subintegra* HARA: Kankakei, Utiumi, Shodo Is., Kagawa Pref., Japan, Akemi DOI, Apr. 26, 1994, OSCU (94A30).

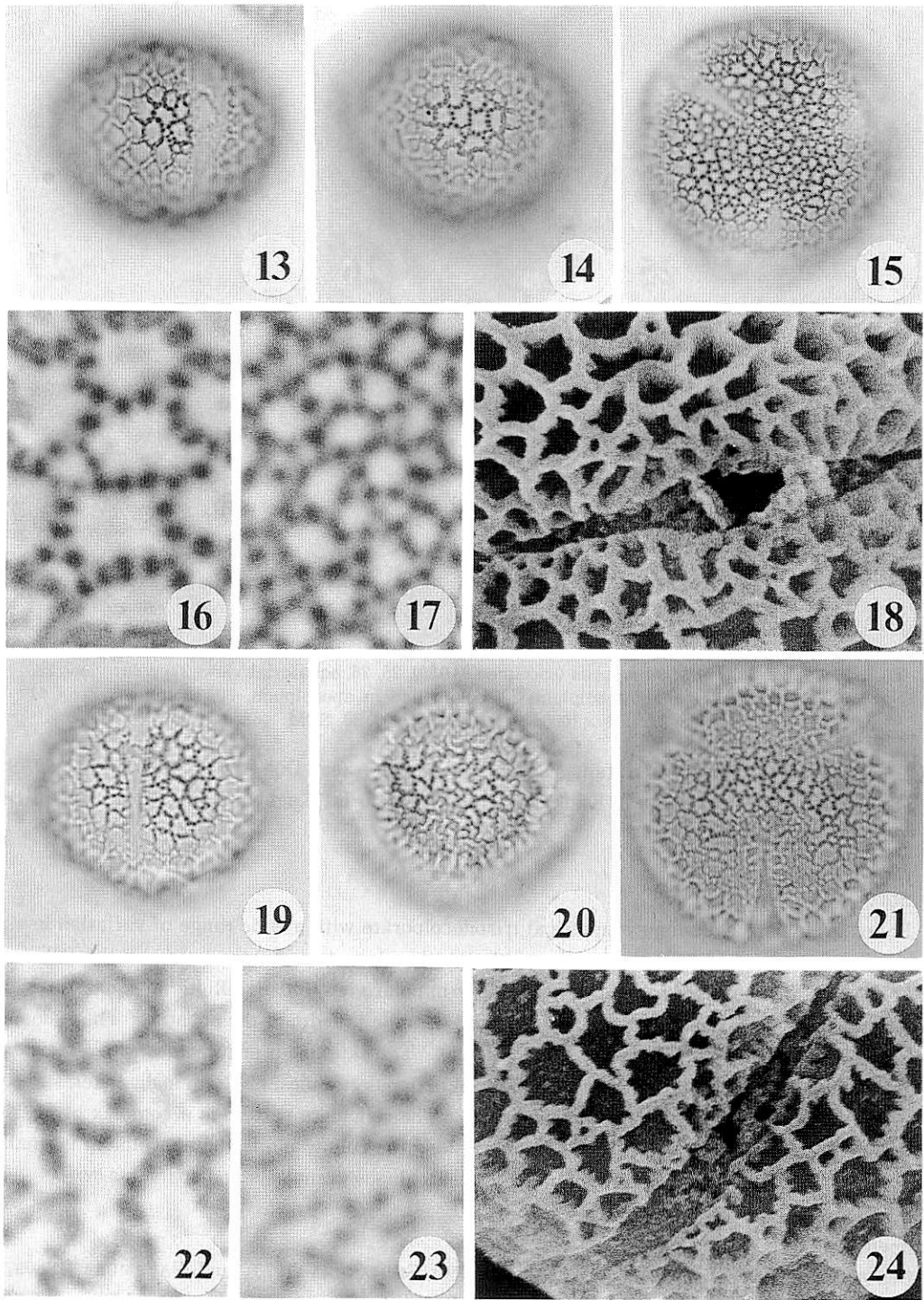
Forsythia viridissima LINDL.: KBG (cultivated), Katano, Osaka Pref., Japan, Akemi DOI, Mar. 29, 1993,

Table 1 Grain size and P/E ratio of *Forsythia*

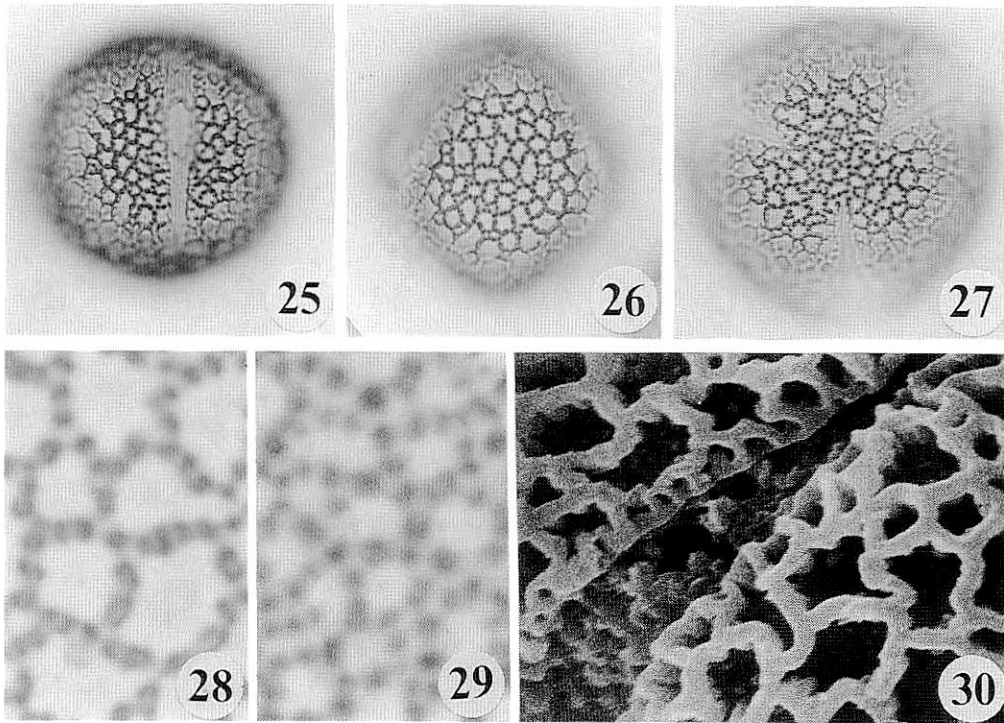
Species and specimens	P(μm)	E(μm)	P/E ratio
<i>Forsythia suspensa</i>			
93A27	28.8-(32.1)-36.3	32.5-(36.9)-41.3	0.8-(0.87)-0.93
93A96	25-(30.5)-35	28.8-(37.0)-41.3	0.75-(0.83)-0.89
<i>Forsythia japonica</i>			
93A2	27.5-(29.2)-32.5	30-(32.4)-35	0.82-(0.90)-1.0
<i>Forsythia japonica</i> var. <i>subintegra</i>			
94A30	26.3-(31.4)-35	31.3-(35.0)-38.8	0.8-(0.90)-0.96
<i>Forsythia viridissima</i>			
93A1	26.3-(30.4)-33.8	27.5-(33.0)-35	0.85-(0.92)-0.96
93A95	26.3-(30.5)-32.5	28.8-(32.5)-35	0.85-(0.94)-1.04
<i>Forsythia koreana</i>			
94A29	27.5-(33.6)-37.5	28.8-(33.6)-38.8	0.71-(1.0)-1.08



Figs. 1-12 1-6, *Forsythia suspensa* (specimen 93A96). 1, 2, equatorial view. 3, polar view. 4, columellae in mesocolpium. 5, columellae in apocolpium. 6, sculpturing around aperture. 7-12, *Forsythia japonica* (specimen 93A2). 7, 8, equatorial view. 9, polar view. 10, columellae in mesocolpium. 11, columellae in apocolpium. 12, sculpturing around aperture. 1-3, 7-9, LM $\times 1000$. 4, 5, 10, 11, LM $\times 5000$. 6, SEM $\times 8600$. 12, SEM $\times 5400$.



Figs. 13-24 13-18, *Forsythia japonica* var. *subintegra* (specimen 94A30). 13,14, equatorial view. 15, polar view. 16, columellae in mesocolpium. 17, columellae in apocolpium. 18, sculpturing around aperture. 19-24, *Forsythia viridissima* (specimen 93A95). 19, 20, equatorial view. 21, polar view. 22, columellae in mesocolpium. 23, columellae in apocolpium. 24, sculpturing around aperture. 13-15, 19-21, LM $\times 1000$. 16, 17, 22, 23, LM $\times 5000$. 18, 24, SEM $\times 6800$.



Figs. 25-30 25-30, *Forsythia koreana* (specimen 94A29). 25, 26, equatorial view. 27, polar view. 28, columellae in mesocolpium. 29, columellae in apocolpium. 30, sculpturing around aperture. 25-27, LM $\times 1000$. 28, 29, LM $\times 5000$. 30, SEM $\times 6800$.

OSCU (93A1); KBG (cultivated), Katano, Osaka Pref., Japan, Akemi DOI, Apr. 15, 1993, OSCU (93A95). *Forsythia koreana* (REHDER) NAKAI: Kankakei, Utiumi, Shodo Is., Kagawa Pref., Japan, Akemi DOI, Apr. 26, 1994, OSCU (94A29).

Results

Pollen grains are emission symmetrical trizonocolporate with a wide range of variation in size, 25- 37.5 μm in length and 27.5-41.3 μm in width, mostly adequate to subtransverse in the P/E ratio class. The outline is circular to convex triangular in polar view, mostly elliptic in equatorial view. The ectoaperture is an elongated tapering colpus, 3-4 μm in breadth at the equator. The endoaperture is an obscure rounded pore (Figs. 1, 7, 13, 19, 25). The ectexine is semitectate with a reticulate pattern and simplicolumellate under muri. Many ectexinous granules, 1.5-2 μm in diameter, stand on the colpus membrane just above the endoaperture. The reticulate pattern is a complex of big and small types of lumina (Figs. 16, 17). The lumina along the colpus and in the apocolpium is smaller than that in the mesocolpium. In the lumina, the ectexinous granules stand sparsely.

Comments

WODEHOUSE (1935), ERDTMAN (1952), IKUSE (1956), SHIMAKURA (1973), and NAKAMURA (1980a, b) described the general characteristics of the pollen morphology of *Forsythia*, i.e., shape of grains, aperture morphology, and structure and sculpturing of exine, based on the observations with LM. From the present study it is apparent that (i) the lumina along the colpus and in the apocolpium is smaller than that in the mesocolpium, and (ii) the granules stand sparsely in lumina. Pollen characteristics suitable for distinguishing each species were not found in the present observations.

Acknowledgements

I wish to thank Mr. H. KOYAMA, the Botanical Garden of the Osaka City University, for the specimens examined, and Dr. S. TSUJI, National Museum of Japanese History, for his help and advice.

References

- ERDTMAN, G. 1952. Pollen Morphology and Plant Taxonomy. Angiosperms. 539pp. Almquist & Wiksell, Stockholm.
- ERDTMAN, G. 1960. The acetolysis method. Svensk Bot. Tidskr., 54: 561-564.
- IKUSE, M. 1956. Pollen Grains of Japan. 303pp. pls. 1-76, Hirokawa Publishing Co., Tokyo.
- MOORE, P. D., WEBB, J. A. & COLLINSON, M. E. 1978. Pollen Analysis. 2nd. ed. 216pp. pls. 1-71. Blackwell Scientific Publications, Oxford.
- NAKAMURA, J. 1980a. Diagnostic characters of pollen grains of Japan Part I. Special Publications from the Osaka Museum of Natural History. Vol. 13. 91pp.
- NAKAMURA, J. 1980b. Diagnostic characters of pollen grains of Japan Part II. Special Publications from the Osaka Museum of Natural History. Vol. 12. pls. 1-157.
- REITSMA, T. 1970. Suggestions towards unification of descriptive terminology of angiosperm pollen grains. Rev. Palaeobot. Palynol., 10: 39-60.
- SHIMAKURA, M. 1973. Palynomorphs of Japanese plants. Special Publications from the Osaka Museum of Natural History. Vol. 5. 60pp. pls. 1-122.
- WODEHOUSE, R. P. 1935. Pollen Grains. 574pp. McGraw-Hill, New York.

(*Department of Biology, Graduate School of Science, Osaka City University, Sugimoto, Sumiyoshi-ku, Osaka 558, Japan. 〒 558 大阪市住吉区杉本 3-3-138 大阪市立大学理学研究科生物学専攻)

(Accepted on May 31, 1995)

書評 (新刊紹介) : 清水達美 (著)・梅林正芳 (図). 1995. 日本草本植物根系図説. 262 pp. 平凡社, 東京.

植物の根の形態に関する研究は, 生殖器官や地上の栄養器官の研究に比べるときわめて乏しい。本書は分類学的・形態学的観点から草本植物の根系について詳細に記述し図解したもので, 近年まれにみる労作である。著者たちは植物の地下器官の形態が分類学上検討されるべき物と考え, 長年にわたって地下器官を観察し, 作図し続けてきた。正確な事実を伝えるため, 根系の標本収集・整理保管に費やされたエネルギーはいかばかりであったか。この隠れた努力が図・解説に迫力を与えているのだと思う。本書の構成は「草本植物の根系」と「図と解説」とからなる。「草本植物の根系」は第1章 草本植物と木本植物, 第2章 草本植物, 第3章 根系, 第4章 地下茎-根茎, 地下匍枝, 特殊茎-, 第5章 根-定根と不定根, 特殊根, 宿存根毛-, 第6章 地下茎の成長と年齢-年齢判定の可否, 真の年齢, みかけの年齢-, 第7章 地下器官の形態と系統・分類-上皮分類群と地下器官, 地下器官の形態と種の識別-という内容で, 根の形態学的成り立ち, 生態学的性質, 分類学的取り扱いといった根に関する様々な事柄について明快に解説している。「図と解説」は本論であり, 日本産草本植物 62 科 212 種 1 変種について根系の詳細な図と解説がつけられている。図には根系の各部位に日本語と英語の説明がついて根系の構造が理解しやすい。最後に資料として, 用語解説や参考文献・索引のほかに「地下器官の形態に基づく種の検索表」がつけられ, 著者らの意欲が感じられる。植物形態学・分類学・生態学に関連する分野にたずさわる者にとって本書の豊富な情報は大変有用であろう。植物の根に対する見方が変わることはまちがいない。

(高橋 晃)