(Short Communication)

Pollen Morphology of *Trapella sinensis* Oliver (Trapellaceae)

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Pollen morphology of *Trapella sinensis* Oliver is described by using light and scanning electron microscopy.

(1) Pollen grains of *Trapella sinensis* are prolate spheroidal to oblate, and tricolpate. They are easily broken along colpi, especially in those of cleistogamous flower.

(2) Pollen grains of chasmogamous flowers: average length of polar axis is 28.3μm; surface pattern is irregularly rugulate; having developed columellae; irregular sculptine and granules on colpi.

(3) Pollen grains of cleistogamous flowers: surface pattern is smooth; exine is thin and columellae are not developed.

(4) Based on pollen morphology, it is supported the classification by Yamazaki, Kadono and Takhtajan that *Trapella* is an independent family from Pedaliaceae.

Key Words : pollen morphology, *Trapella sinensis*, light microscopy, scanning electron microscopy.

Introduction

The genus *Trapella* is a monotypic genus comprising *T. sinensis* Oliver, an aquatic plant distributed in the eastern Asia[1, 2, 3]. *Trapella sinensis* grows in bogs, ponds, lakes, and paddy fields with gentle streams. It is known that *T. sinensis* bears cleistogamous flowers as well as chasmogamous ones.

Although *Trapella* has been included in Pedaliaceae[1, 2, 3, 4], some botanists treated this as an independent family, Trapellaceae, by difference of floral characters such as ovary, ovule and fruit structure[5, 6, 7].

Erdtman[8], Straka and Ihlenfeldt[9] and Singh[10] reported pollen morphology of *T. sinensis* and noted that it was quite different from that of other members in Pedaliaceae. However they gave only short descriptions, and did not mention about difference of pollen morphology between chasmogamous and cleistogamous flowers. Moreover a large palynological literature in Japan do not deal with the pollen morphology of the genus *Trapella*.

Paleoecologically, *Trapella* is expected to be a good indicator of wet environment in the past. Although fossil seeds of *Trapella* were recorded from the Quaternary deposits in Japan, pollen grains of *Trapella* have not been reported. The reason why is speculated as follows : 1) there is no literature describing accurate pollen morphology of *Trapella* with photographs or fine figures, and 2) the pollen is poorly preserved in deposit.

This paper aims to provide description of pollen morphology of *T. sinensis* in detail by using light microscopy (LM) and scanning electron microscopy (SEM).

Materials and Methods

Pollen grains were taken from living materials collected from a pond in the Okayama Prefectural Nature Conservation Center, Saeki-cho, Wake-gun,

Okayama Prefecture, western Japan. Voucher specimens are preserved in the herbarium of Okayama University of Science (H. Kataoka s.n., 28 July 2001).

The sample for LM observation was prepared as follows : 1) acetolysed for 10 min. (9 : 1 acetic anhydride: conc. sulfuric acid), 2) washed with glacial acetic acid, 3) washed with water, 4) heated for a short time with 10% KOH, 5) washed with water, and 6) mounted in glycerin jelly with fuchsin staining. A Nikon Equipse Microscope with a × 10 ocular and a × 100 objective were used for measurement. Microphotographs were taken with a Zeiss equipment with a × 63 plano-apochromat objective. For SEM observation, acetolysed grains were fixed in 2% osmium tetroxide, and then mounted on a brass stub and coated with gold-palladium for six minutes. The micro-photographs were taken using a JEOL JSM-890 SEM.

Results and Discussion

(1) Pollen grains of chasmogamous flowers

Pollen grains are prolate spheroidal to oblate, and tricolpate (Fig. 1, Pl. 1C-F & 2).

On LM, some pollen grains were much bigger than others and they did not have colpi (35 grains among 284 grains). They seemed to be opened or broken along copli in the course of treatments. We could measure fourteen grains. The average length of polar axis was 28.3 (24.0 - 33.9) μm. The surface of pollen grain was irregularly rugulate. Exine layer was 1.3 (1.0 - 2.0) μm thick with developed columellae. Sexine layer showed almost the same thickness through mesocolpium, while nexine layer was developed at the central part of mesocolpium.

(2) Pollen grains of cleistogamous flowers

We observed two types of pollen grains. One type was those of bigger and without colpi (57 grains among 87 grains). Another was those of smaller and tricolpate. Both types had smooth surface and very thin (<0.5 μ m) sexine layers (Pl. 2 C). Columellae were not developed in the sexine layer. We could not measure the size of pollen grains because all grains were opened or broken along colpi in the course of treatments.

Pollen grains of *Trapella* are much different from those of *Sesamum* and *Proboscidea* in Pedaliaceae (Pl. 1 A-B). Pollen grains of *Sesamum* are usually round, 11-13 colpate, parasyncolpate, and scabrate to clavate on surface (Pl. 1 A). Pollen grains of *Proboscidea* are nonaperturate, areolate, and reticulate on surface (Pl. 1 B). It is supported the classification by Yamazaki [5] , Kadono [6] and Takhtajan [7] that *Trapella* is an independent family from Pedaliaceae.

Pollen grains of cleistogamous flowers have thinner sclerine layers than those of chasmogamous flowers. It is thought that they do not need to have thick/hard sclerine layers because they pollinate in the same flowers. Kadono [6] noted from the field observation that production of chasmogamous flowers is limited and the fructification from cleistogamous flowers is common in *T. sinensis*. *Trapella sinensis* may reproduce mainly by the result of pollination in cleistogamous flowers.

Both the pollen grains of chasmogamous and cleistogamous flowers of *T. sinensis* are easily opened or broken along colpi in the course of treatments. It is thought that pollen grains of *T.*

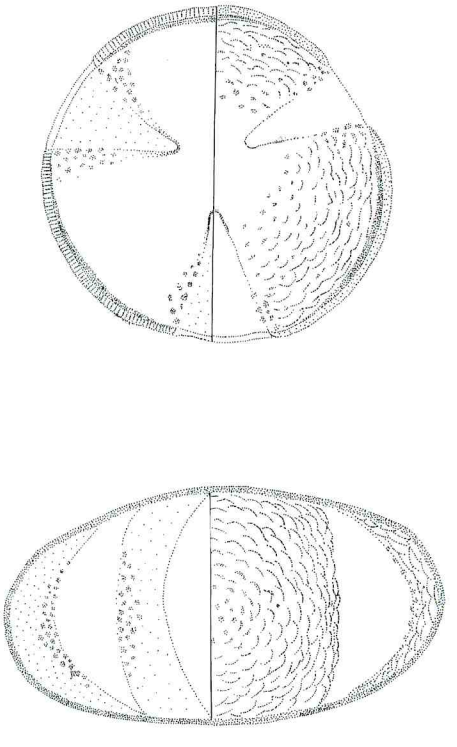

Fig. 1. Schematic figure of modern pollen grain of chasmogamous flower of *Trapella sinensis*.

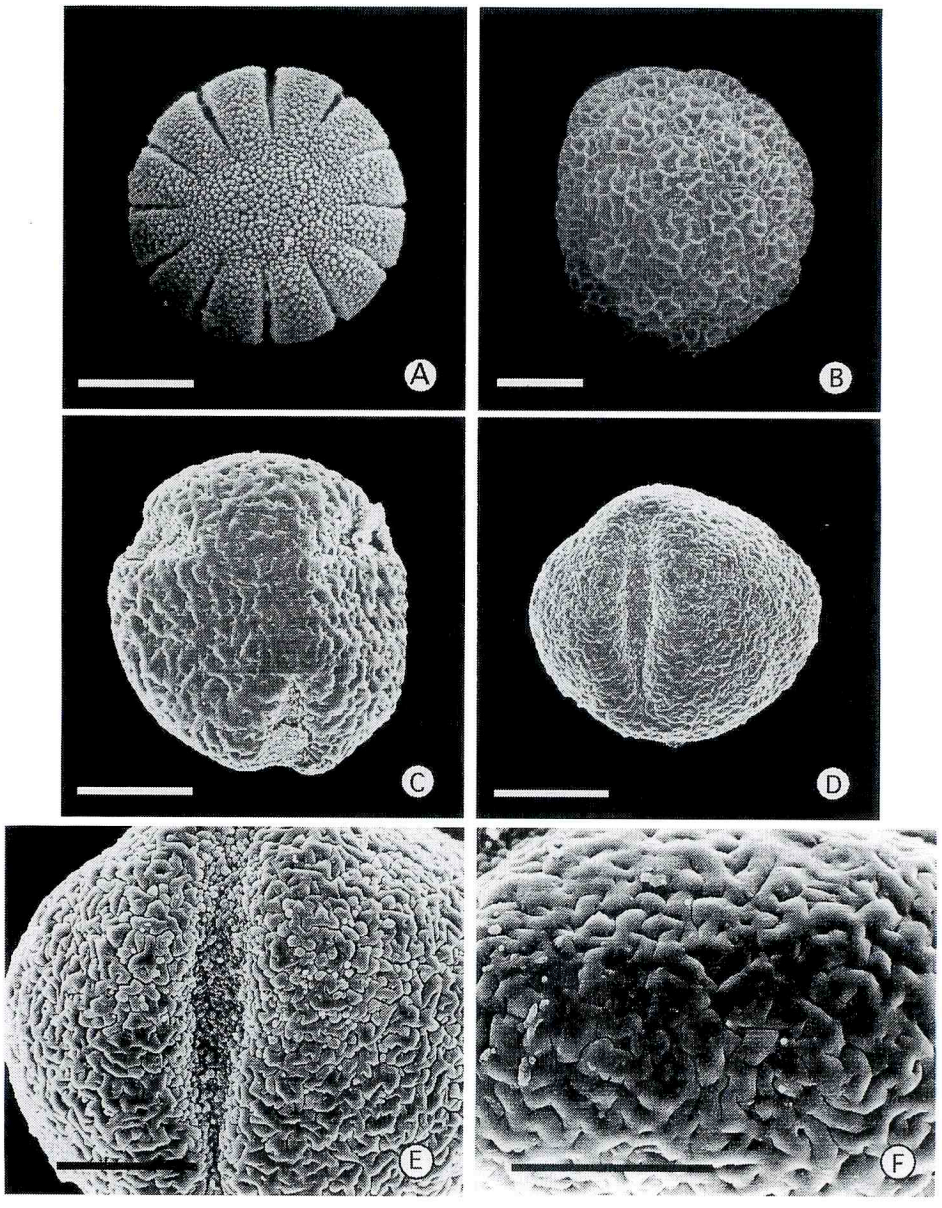

Plate 1. Modern pollen grains of *Sesamum indicum* (A), *Proboscidea jussieui* (B) and chasmogamous flower of *Trapella sinensis* (C - F) by SEM (C : polar view, D : equatorial view. A-D : white lines correspond to 10μm). Surface detail of pollen grains of *T. sinensis* (E : colpi, F : mesocolpium. E & F : black lines corrspond to 5μm).

sinensis are hardly remained in deposits for the fragile pollen walls, and that is the reason why there is no credible report of *T. sinensis* from deposits.

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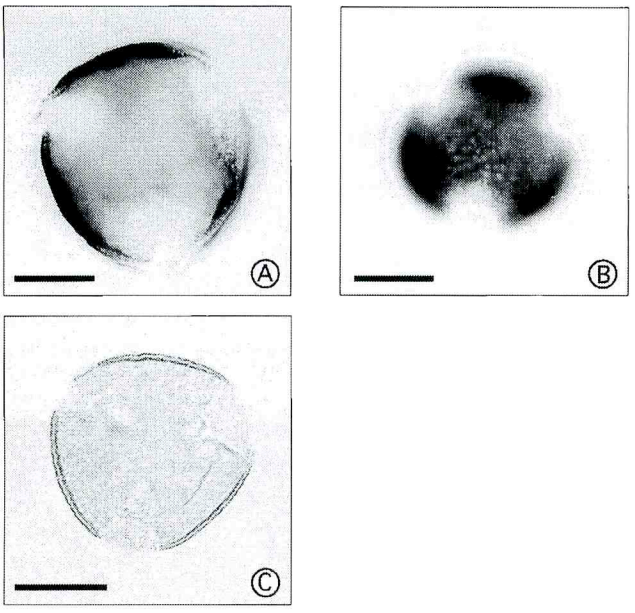

Plate 2. Modern pollen grains of chasmogamous flower of (A & B) and cleistogamous flower (C) of *Trapella sinensis* by LM. Polar view (black lines correspond to 10μm).

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ヒシモドキ（*Trapella sinensis* Oliver）の花粉形態

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ヒシモドキ属はヒシモドキ（*Trapella sinensis* Oliver）1種からなる単型属で，東アジア温帯の湖沼や池に分布する．本属はこれまでゴマ科に分類されてきたが，子房や胚珠などの形質から，ヒシモドキ科として独立させる見解もある．ヒシモドキは湿性環境を指標する植物として有効だと考えられるが，古生態学的には，第四紀堆積物中から種子が発見された報告はあるものの，化石花粉の報告はない．その原因として，これまで図版や写真を伴った詳細な花粉形態の記載がなく同定が困難であったことと，花粉が堆積物中に残り難いことが考えられる．また，本種は開放花と閉鎖花をつけることが知られているが，開放花と閉鎖花の花粉を区別して記載されたことはなかった．

そこで，光学顕微鏡および走査電子顕微鏡を用いて，本種の開放花と閉鎖花の花粉の詳細な観察を行った．その結果，以下のことが明らかになった．

（1）花粉は長球状球形（prolate spheroidal）？偏球形（oblate），三溝型（tricolpate）である．開放花・閉鎖花ともに溝（colpi）が開きやすい．

（2）開放花の花粉の極軸長は平均28.3μm，表面は不規則なしわ模様型（rugulate）であり、柱状層（columella）がよく発達している．溝には不規則な彫紋があり，顆粒（granules）を伴う．

（3）閉鎖花の花粉の表面はほぼ平滑で，柱状層はあまり発達しない．

（4）本属は，ゴマ属・ツノゴマ属とも大きく異なる花粉形態をしていることから，花粉の形態学的見地からもゴマ科に入れるよりも，独立したヒシモドキ科とするのが妥当であると思われる．