

マツ属の微細花粉形態

山田 義男*

Pollen micromorphology in *Pinus* (Pinaceae)

Yoshio YAMADA*

(Received May 18, 1984)

Introduction

Pinus pollen grains are very similar in their external morphology and cannot be distinguished from each other on these characteristics alone: All are symmetrical in equatorial views and the centers of the lobes are positioned on the long axis of the ellipse that delimits the outer boundary of the grain. Moreover, the outer surface of the grain lacks any ornamentation when viewed with the light microscope. Photographs or drawings generally lack details necessary for comparative studies. Such details can be obtained with the scanning electron microscope (SEM). Earlier SEM studies on pollen have clearly shown that micromorphological characters of ectexine surfaces can be of taxonomically diagnostic value.⁽¹⁻⁴⁾

For comparative purpose, as well as to indicate possible trends within the genus, pollen were

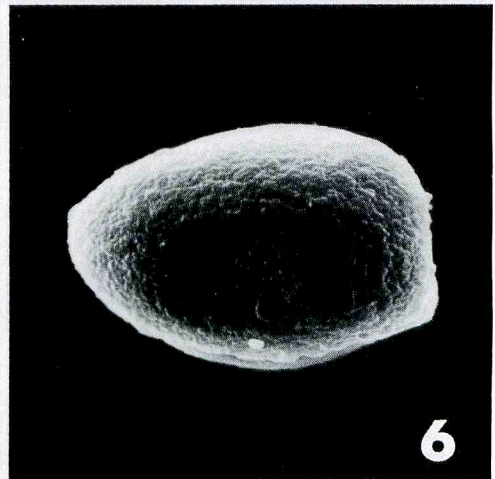
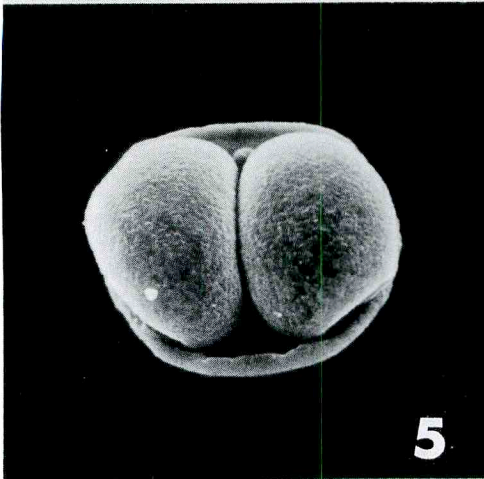
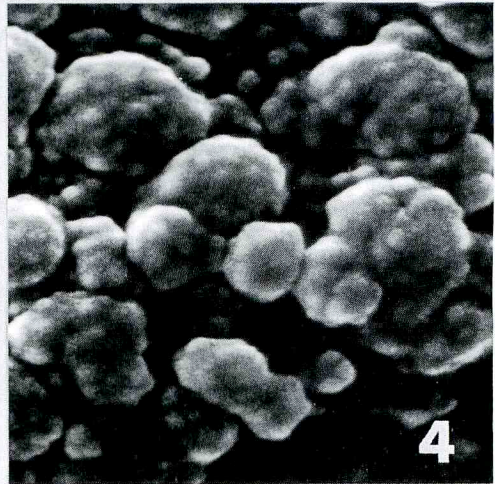
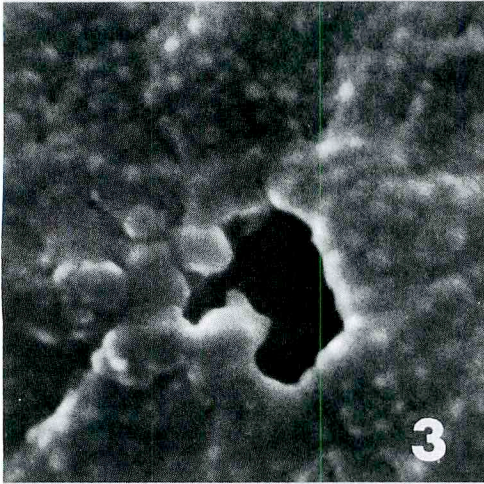
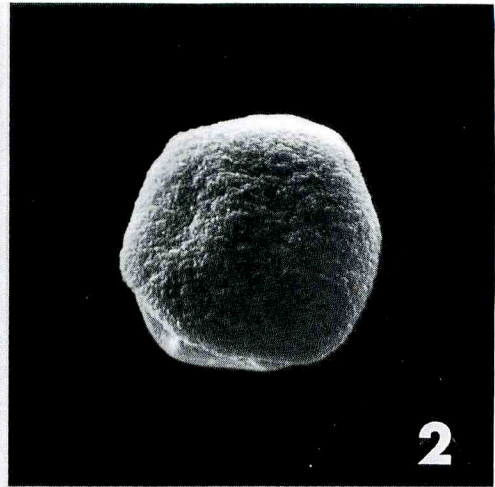
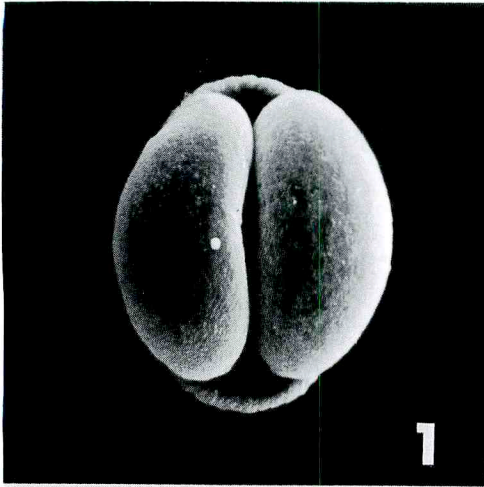
examined from three species of *Pinus*.

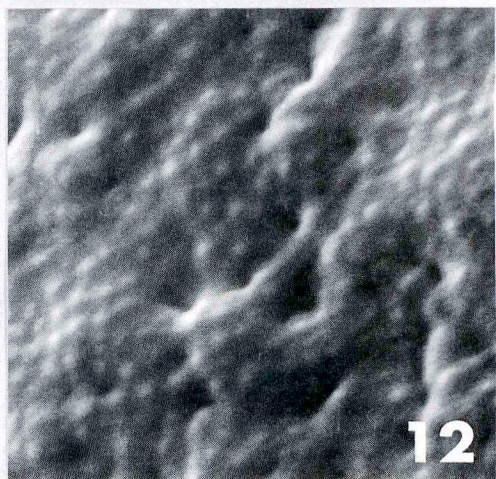
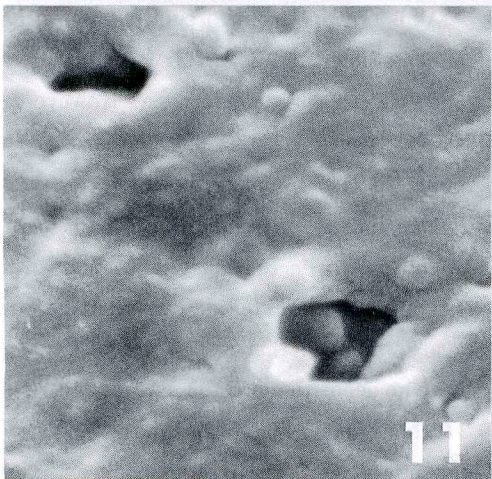
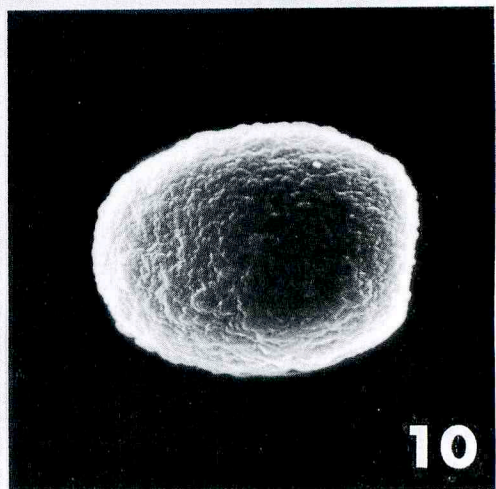
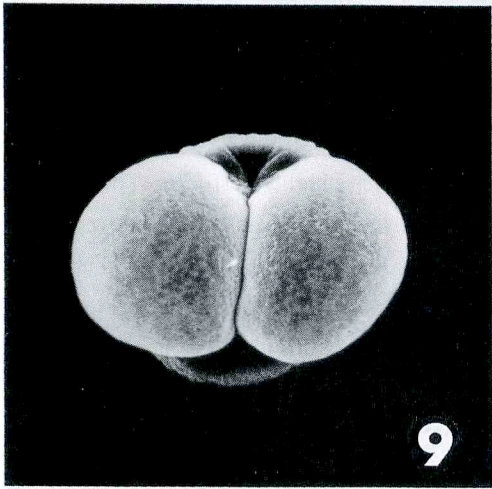
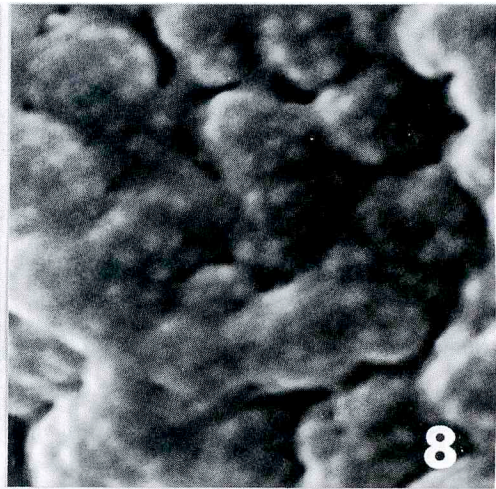
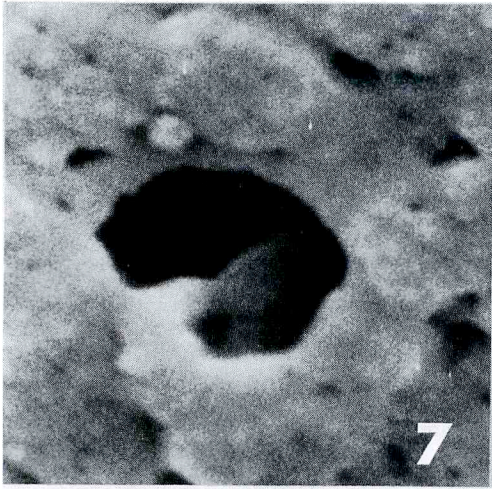
Materials and Method

The cultivated material of *Pinus densiflora* Sieb. et Zucc., *P. densiflora* Sieb. et Zucc. var. *umbraculifera* Mayr and *P. Thunbergii* Parl. was collected in the field in the period of april-may 1982. The specimens for SEM were allowed to air dry at room temperature for about 30 min. After air drying, specimens was attached to stubs by double-sticky tape and placed in a vacuum-evaporator with a rotating stage for coating carbon and gold. Charging was evident immediately and increased rapidly so the micrographs were taken within as short a time as possible. The specimens were examined and photographed in JEOL JEM-15 scanning electron microscope operated at 15 kV. Size calculations were approximate because of the variable specimen to beam angles inherent in the SEM.

* 群馬大学教育学部生物学教室 〒371 前橋市荒牧町4-2

Department of Biology, Faculty of Education, Gunma University, 4-2 Aramaki-Cho, Maebashi, Gunma, Japan





Results and Discussion

As illustrated by *P. densiflora* (Fig. 1), var. *umbraculifera* (Fig. 5) and *P. Thunbergii* (Fig. 9), the two lobes of the saccus occupy most of the distal face with the exception of a narrow sulcus, are hemispherical, and are situated opposite one another on the body of the grain. The body of the grain ranges from circular to oval in outline (Fig. 2, 6, 10). At least 20 pollen grains were measured from each sample utilizing light microscope. In all species the breadth of the body ranges from 41 to 48 μ m and averages 43 μ m. The length of the body ranges from 42 to 58 μ m and averages 49 μ m.

P. densiflora (Fig. 1-4) ——— Under lower magnification (Fig. 1) the surface of saccus smooth, provided with minute, distinct perforations. The perforations are rounded and sparsely distributed but the size of perforations varies. At higher magnification (Fig. 3) the surface of saccus is reticulate and has a surface ornamentation consisting of small verrucae. The verrucae averaged ca 80 nm in diameter and 50 nm in height. These are densely and evenly distributed.

The ektexine of the body is formed by granulose unit (Fig. 4). Their surface is covered uniformly with verrucae of the same size and shape as the verrucae on the surface of saccus. Each granulose unit is somewhat irregular in size and shape. Another conspicuous feature of granulose units is its occurrence in fused aggregates. Clusters of two or more units are shown in Fig. 4. Varying degrees of fusion between doublets are observed. This type of granulose structure of ektexine occurs in the closely related var. *umbraculifera*.

P. densiflora var. *umbraculifera* (Fig. 5-8) ———
— The ektexine is similar to that of *P. densiflora*,

but the granulose structure is comparatively more reduced. Therefore, it appears as a coarse rugulum with verrucae; intersculptural tectum is difficult to define, and perforations are lineated.

The surface of saccus is verrucate to gemmate with many gemmae fused to one another; perforations are sparse.

P. Thunbergii (Fig. 9-12) ——— Although *P. densiflora* and *P. Thunbergii* are alike in many respects, some important differences clearly separate these two species. In *P. Thunbergii* the ektexine surface is verrucate and delicately undulate and appears more highly perforate; the verrucae are densely and evenly distributed; the perforations are small and evenly distributed.

The surface of saccus may be relatively smooth and appears highly perforate. The ornamentation is markedly different from above two species. Few faint perforations are seen which are smaller than those of *P. densiflora*. It appears that there is heavy deposition of some mucilaginous material which obliterates the ornamentation of saccus so that at higher magnification (Fig. 11) the surface appears somewhat smooth.

As is obvious from foregoing observations the pollen studies are dissimilar in both the ektexine and saccus ornamentations. However, some similarity between the ektexine structure of the pollen of *P. densiflora*, var. *umbraculifera* and *P. Thunbergii* is apparent. From *P. densiflora* to *P. Thunbergii* a decreasing gradation of granulose structure of the ektexine can be made out. It is also interesting that the saccus of *P. densiflora* have no deposition on their surface, whereas those of the other two species have an increasing amount of deposition starting from var. *umbraculifera*, and reaching maximum in *P. Thunbergii*. The substance deposited on the surface is still

unknown.

Although only three species of *Pinus* have been examined in the present study, it is readily apparent that *P. Thunbergii* stands apart from *P. densiflora* and var. *umbraculifera* at micromor-

phological levels. Without additional studies it is not possible to draw definite conclusions concerning species recognition, but the apparent heterogeneity which exists within *Pinus* should make such studies rewarding.

Explanation of Figures

Fig. 1-4 — *Pinus densiflora*

- 1 . Pollen grain in equatorial view showing ornamentation of the lobes of the saccus. $\times 800$.
- 2 . Pollen grain in oblique proximal view showing ornamentation of the body. $\times 800$.
- 3 . Surface portion of the saccus enlarged to show verrucae and perforations. $\times 24000$.
- 4 . A part of the enlargement of Fig. 2. Each granulose unit is somewhat irregular in size and shape. Note aggregate of partially fused granulose units. $\times 24000$.

Fig. 5-8 — var. *umbraculifera*

- 5 . Equatorial view of pollen grain. $\times 800$.
- 6 . Proximal view of the body of pollen grain. $\times 800$.
- 7 . Detail of the surface of saccus. Ornamentation is verrucate to gemmate, with sparse perforations. $\times 24000$.
- 8 . Enlarged portion of the body showing irregularly rugulate ektexine with verrucae ; no intersculptural tectum surface can be defined ; perforations lineate. $\times 24000$.

Fig. 9-12 — *Pinus Thunbergii*

- 9 . Equatorial view of pollen grain. $\times 800$.
- 10 . Proximal view of the body of pollen grain. $\times 800$.
- 11 . A part of the enlargement of Fig. 9 ; Verrucae and perforations are obliterated probably due to the presence of surface mucilage. $\times 24000$.
- 12 . A part of the enlargement of Fig. 10. In contrast to Fig. 4 and Fig. 8 the ektexine surface is verrucate and delicately undulate. Perforations are small and densely distributed. $\times 24000$.

References

- 1) Ueno, J. (1978) Study of Palynology. Kazama Shobo, Tokyo (in Japanese).
- 2) Argue, C.L. (1980) Amer. J. Bot., **67**, 68-87.
- 3) Simpson, B.B. and J.J. Skvarla (1981) Amer. J. Bot., **68**, 277-294.
- 4) Dickison, W.C., J.W. Nowicke and J.J. Skvarla (1982) Amer. J. Bot. **69**, 1055-1073.

要 約

マツ属の3種、アカマツ・タギョウショウ・クロマツの花粉の微細構造を走査電顕で調べた。その結果、花粉外壁の彫紋は種によって互いに異なることが明らかになった。アカマツでは、外壁は多数の顆粒状の単位粒子からできていて、各単位粒子の表面は一樣にいぼ状突起で被われている。アカマツの変種であるタギョウショウでは、外壁の彫紋はしわ模様型で、その表面にはいぼ状突起と小孔がある。なお、しわ模様の境界は不鮮明であり、小孔は直線状に連なっている。クロマツでは、外壁表面はほとんど平滑で、その表面にはいぼ状突起があり、また多数の小孔を持っている。いぼ状突起は密に一樣に分布し、小孔も一樣に分布している。このように、花粉外壁の彫紋の相違は、1属中の種の識別をするのに、もう1つの特性として用いることができる。

Summary

Pollen from three species of *Pinus* was examined in detail : *Pinus densiflora* Sieb. et Zucc., *P. densiflora* Sieb. et Zucc. var. *umbraculifera* Mayr and *P. Thunbergii* Parl. The ektexine surface as studied by scanning electron microscope revealed ornamentations which differed considerably from species to species. In *P. densiflora* the ektexine is composed of granulose unit. Their surface is covered uniformly with verrucae. In var. *umbraculifera* the ektexine surface is rugulate with verrucae ; intersculptural tectum is difficult to define, and perforations are lineated. In *P. Thunbergii* the ektexine surface is verrucate and appears highly perforate : the verrucae are densely and evenly distributed ; the perforations are small and evenly distributed. Thus, the differences in the ektexine ornamentation provided additional characters, which can be of use in the distinction of species of the genus.

新著紹介 図説花粉—走査電顕写真を中心として (1984)

著者の岩波洋造・山田義男両氏は日本花粉学会の古い会員である。走査電顕写真は山田が、光顕写真と図は岩波が担当している、6章からなり、第1章は花粉の誕生。第2章は花粉の形態。第3章は受粉と花粉の成長。第4章は花粉の生理。第5章は空中花粉とアレルギー。第6章は土中の花粉となっている。花粉一般の知識を得るのには適当である。19×26 cm. pp. 152。講談社 3,200円