Ultrastructure of pollen grain sculpturing in several species of the *Rosaceae* family

JÓZEF KOCON*, STANISŁAW MUSZYŃSKI**

* Laboratory of Electron Microscopy, Warsaw Agricultural University, Rakowiecka 26/30, 02-528 Warsaw, Poland

** Institute of Genetics and Plant Breeding, Warsaw Agricultural University, Nowoursynowska 166, 02-766 Warsaw, Poland

(Received: January 18, 1982)

Abstract

The sculpturing patterns of pollen grains in some species of the *Rosaceae* family were analyzed by SEM. Three patterns are described, typical for *Prunus spinosa*, *Pyrus eleagrifolia* and *Crataegus* sp. The role of SEM analysis of sculpturing patterns in taxonomy can be compared to the "finger print" method in chemical plant taxonomy.

INTRODUCTION

SEM analysis of pollen grain surface proved to be irreplaceable in taxonomic examination of higher plants (Faegri and Iversen 1975, Fogle 1977 a, b, Mass 1977, Westwood and Challice 1978). It was demonstrated that pollen grains form characteristic features typical for taxonomic units. The surface sculpturing of the pollen grains can be compared to the "finger print" method in chemical plant taxonomy.

MATERIALS AND METHODS

Pollen grain samples were collected in the Botanical Garden of the Warsaw University. The following species from the *Rosaceae* family were analyzed: *Amelanchier canadensis*, *Crataegus* sp., *Prunus avium*, wild and a cultivar, *Prunus cerasifera*, *P. cerasifera* var. *divaricata*, *P. cerasus* cv. Łutówka, *P. padus*, *P. spinosa*, *P. tomentosa*, *P. triloba plena*, *Pyrus eleagrifolia*. Scanning Electron Microscopic (SEM) analysis was performed as already described (Muszyński et al. 1977).

RESULTS AND DISCUSSION

The pollen grains analyzed were prolate and tricolpate, with the exception of *Crataegus* in which the grains were globular. This is in agreement with descriptions of other authors (Fogle 1977 a, b, Maas 1977, Westwood and Challice 1978). Variation in pollen grain dimensions is not great (Table 1). The sculpturing of the pollen grains is well developed. The species analyzed can be classified to three groups according to the pattern of sculpturing. The most common is the pattern represented by *Prunus spinosa*.

Table 1

Pollen grain dimensions in several species of the *Rosaceae* family

Pollen grain dimensions, μm		
Plant species	length	width
<i>Amelanchier canadensis</i>	40.0-42.5	21.5-23.5
<i>Crataegus</i> sp. (diameter)		36.5-44.5
<i>Prunus avium</i> , wild	35.0-48.5	24.0-29.0
<i>Prunus avium</i> , cv. Łipcówka	44.5-51.0	23.0-24.0
<i>Prunus cerasifera</i>	32.5-46.0	16.5-21.5
<i>Prunus cerasifera</i> var. <i>divaricata</i>	39.5-40.5	19.0-19.5
<i>Prunus cerasus</i> cv. Łutówka	46.0-51.0	21.5-23.0
<i>Prunus padus</i>	25.5-35.0	18.5-24.5
<i>Prunus spinosa</i>	44.0-50.0	22.5-28.0
<i>Prunus tomentosa</i>	32.0-36.0	22.0-22.5
<i>Prunus triloba</i> var. <i>plena</i>	49.0-52.0	25.0
<i>Pyrus eleagrifolia</i>	40.0-44.0	20.5-23.0

The pollen grains of *Prunus spinosa* are of striata type and form prominent and very dense or dense, mainly single or branched, mostly bifurcated, valae (lirae) which are arranged longitudinally on the whole surface of a grain (Fig. 1 a, b, c, d). In some places, mainly close to the grain poles, the valae are curved or bent. The "lumina" are lacking or occur scarcely. The same type of striata sculpturing, with some modifications, occurs in other *Prunus* species as *P. avium*, *P. cerasus*, *P. cerasifera*, *P. padus*, *P. tomentosa* and *P. triloba*.

In wild plants of *P. avium*, the sculpturing is very similar to the *spinosa* type. The valae are very regular and single, forming long rows of crests and ridges along whole grains, bending only over the grain poles, and no "lumina" are visible (Fig. 2 a, b).

P. cerasus cv. Łutówka represents the pattern of pollen grain sculpturing of the *P. spinosa* type and almost identical with that of *P. avium*. The

See on the next page

Fig. 1. Pollen grains of *Prunus spinosa*: a—a grain, 2 000 x; b-d—details of the sculpturing (b—4 000 x, c—10 000 x, d—10 000 x)

Fig. 2. Pollen grains of wild *Prunus avium*: a—a grain, 2 000 x; b—a detail, 10 000 x

Fig. 3. Pollen grains of *Prunus cerasus* cv. Łutówka: a and b—details, 40 000 x

See on the next page

Fig. 4. Pollen grains of *Prunus cerasifera*: a—a grain, 2 000 x; b—d—details (b—4 000 x, c—6 000 x, d—10 000 x)

Fig. 5. Pollen grains of *Prunus padus*: a and b—details (a—4 000 x, b—6 000 x)

Fig. 6. Pollen grains of *Prunus tomentosa*: a and b—details (a—4 000 x, b—10 000 x)

Fig. 7. Details of pollen grains of *Prunus yedoensis*: a—6 000 x, b—4 000 x

Fig. 8. Details of a pollen grain of *Prunus triloba* var. *plena*, 4 000 x
Fig. 9. See on the next page

Fig. 9. Details of pollen grains of *Prunus avium* cv. Lipcówka: a—4 000 x, b—4 000 x, c—10 000 x

Fig. 10. Details of pollen grains of *Pyrus eleagrifolia*: a—4 000 x, b—10 000 x

Fig. 11. Pollen grains of *Crataegus* sp.: a—a grain, 2 000 x, b—a detail, 10 000 x

only difference is that in cv. Łutówka a few "lumina" are seen (Fig. 3 a, b).

In *P. cerasifera* the valae are very regularly shaped, single or sometimes bifurcated, bent or transverse at the grain poles, and the "lumina" are more or less frequent (Fig. 4 a, b, c, d). In *P. cerasifera* var. *divaricata*, the sculpturing is identical with the previous one.

In *P. padus* the valae are, in some places, transversely folded and a few "lumina" are visible (Fig. 5 a, b). In *P. tomentosa*, the valae are very dense, curved and even folded at the grain poles (Fig. 6 a, b). In *P. triloba*, the valae are transversal at the grain poles and whorled in central regions, and the "lumina" are already frequent (Fig. 8). In *P. yedoensis* the sculpturing is almost identical with the *P. spinosa* type, with the valae bent over the poles or interwoven in the pole regions of the grains, and the "lumina" are lacking or occur sporadically only (Fig. 7 a, b). In *Amelanchier canadensis*, the sculpturing is of the *P. spinosa* type, resembling very much the pattern of *P. cerasifera*.

P. avium cv. Lipcówka represents a different pattern of sculpturing, namely the striato-reticulata type. The muri are separated by rather broad and shallow ridges with frequent lumina of irregular sizes and shapes. The muri are often branched, curved and bent (Fig. 9 a, b, c). Such a pattern was also found in *Pyrus eleagrifolia* (Fig. 10 a, b). Since in that species the sculpturing is more distinct, we name the pattern the *eleagrifolia* type. In that type the muri are bent also in central regions of the pollen grains. Such a type was not observed by Westwood and Challice (1978) in their review of sculpturing patterns in the genus *Pyrus*.

The pollen grains of *Crataegus* sp. were globular, but also tricolpate. Their sculpturing is quite different from other species analyzed (Fig. 11 a, b). It is also of the striato-reticulata type. The muri are mostly branched, curved, bent and interwoven, forming very characteristic striato-reticulata pattern. No lumina or sporadic only.

The results obtained show that the sculpturing of pollen grain surface is different in various taxonomic units. In some genera, like in *Prunus*, the patterns are rather similar. On the other hand, such genera as *Pyrus* and *Crataegus*, form very different patterns, distinguishing them from the previously mentioned ones. It should be kept in mind, however, that the genus *Amelanchier* shows the *Prunus spinosa* pattern. As seen in the figures of Fogle's paper (1977 a), the patterns of different apple cultivars may show greater differences than observed between *Prunus* species. Therefore, it should be reasonable to compare the variation in pollen sculpturing occurring within a species with that existing in a genus or a family.

Nevertheless, the pollen sculpturing patterns can be very useful in identifying the taxonomic units of plants. In that respect, the sculpturing patterns can be compared to the "finger print" patterns in chemical plant taxonomy.

It is obvious that the patterns are hereditary. Further research in that respect is required, however.

Acknowledgment

The kind help of Mgr. B. Sopińska from the Botanical Garden in collecting the pollen samples is acknowledged.

REFERENCES

- Fægri K., Iversen J., 1975. Textbook of pollen analysis. 3rd ed. Munksgaard, Copenhagen. (Polish ed. 1978, PWN, Warszawa).
- Fogle H. W., 1977 a. Identification of clones within four tree fruit species by pollen exine patterns. J. Amer. Soc. Hort. Sci. 102: 552-560.
- Fogle H. W., 1977 b. Identification of tree fruit species by pollen ultrastructure. J. Amer. Soc. Hort. Sci. 102: 548-551.
- Maas J. L., 1977. Pollen ultrastructure of strawberry and other smallfruit crops. J. Amer. Soc. Hort. Sci. 102: 560-571.
- Muszyński S., Kocoń J., Guzewski W., Bieguński M., 1977. The ultrastructure of pollen grain surface in allotetraploid petunia (*Petunia hybrida* hort. *superbissima*) as revealed by scanning electron microscopy. Acta Soc. Bot. Pol. 46: 599-600.
- Westwood M. N., Challice J. S., 1978. Morphology and surface topography of pollen and anthers of *Pyrus* species. J. Amer. Soc. Hort. Sci. 103: 28-37.

Ultrastruktura urzeźbienia ziarna pyłku u kilku gatunków z rodziny różowatych (Rosaceae)

Streszczenie

Urzeźbienie powierzchni ziarn pyłku, obserwowane za pomocą mikroskopu elektronowego odbiciowego (skanującego), tworzy charakterystyczne wzory, typowe dla poszczególnych jednostek systematycznych i może służyć jako cecha diagnostyczna. Znaczenie tej metodyki może być porównane do metody „odcisków placów” (“finger print”), stosowanej w chemotaksonomii. U badanych gatunków i rodzajów z rodziny różowatych można wyróżnić trzy charakterystyczne typy urzeźbienia, a mianowicie typ *Prunus spinosa*, typ *Pyrus eleagrifolia* i typ *Crataegus*.