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Pollen morphology of Picolit grown in different Italian regions[1])

by

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Pollenmorphologie von Picolit aus verschiedenen italienischen Regionen

Zusammenfassung. — Die Pollenkörner mehrerer Biotypen von Picolit giallo wurden mittels Raster- und Transmissionselektronenmikroskop untersucht. Alle geprüften Pollenkörner waren acolporat, d. h. ungefurcht und porenlos. Man darf deshalb annehmen, daß es sich hierbei um ein genetisches Merkmal handelt, das von Pfropfpartner, Ertragsleistung und Herkunft unabhängig ist.

Im Gegensatz zu Picolit-giallo-Pollen besitzen die Pollenkörner von Picolit nero (eine reichtragende rotbeerige Rebensorte) wie die Pollenkörner von Rebsorten normaler Fruchtbarkeit drei Keimfurchen.

Introduction

In previous papers (Lombardo *et al.* 1976 and 1978), we observed that pollen grains of *Vitis* are generally colporated with three furrows and three pores; nevertheless, in some cultivars (Picolit giallo, Razaki rosso, Bicane, Ceresa and Moscato rosa) we found acolporated pollen grains showing a continuous sporopollenin wall, without furrows and germinative pores. Pollen grains with this structure seem unable to germinate; thus, we supposed that this condition could represent the most important reason of the low yield observed in these cultivars.

Concerning the two examined clones of Picolit giallo (Lombardo *et al.* 1978), we noticed that the pollen grains always appear acolporated, even in plants with normal fruit production. On the other hand, the pollen wall morphology of Razaki rosso appears different in the two examined cultivars with different productivity (Lombardo *et al.* 1978). In fact, in Razaki rosso with low productivity (similar to that of Picolit giallo 31 A.A.G.), the wall is continuous, while in that with normal productivity, the pollen wall shows furrows and germinative pores.

Therefore, we thought it extremely interesting to extend our researches to the pollen morphology of numerous Picolit biotypes, in order to investigate if its characteristic lack in furrows and germinative pores keeps always unchanged in clones, whether they show different productivity, or are grafted on different rootstocks, or are grown in different localities.

Materials and methods

Biotypes of Picolit coming from all the Italian regions, where its cultivation is known, were studied. In the Table, we summarize the Picolit biotypes examined,

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Survey of the investigated Picolit biotypes, their productivity and pollen wall morphology
Übersicht über die untersuchten Picolit-Biotypen, ihre Produktivität und Pollenwandmorphologie

Wine farm	Locality	Clone	Rootstock	% of productivity	Pollen wall
Picolit giallo:					
Russiz (Villa)	Capriva del Friuli (GO)	31 A.A.	5 BB	40	—
Badoglio	Codroipo (UD)	—	5 BB	5	—
Dorigo, G.	Manzano (UD)	—	5 BB	15	—
Marin, G.	Cividale (UD)	,31 A.A.	5 BB	85	—
Marin, G.	Cividale (UD)	27 A.A.	5 BB	45	—
Nalon, A.	Nimis (UD)	—	5 BB	70	—
Nalon, A.	Nimis (UD)	—	5 BB	5	—
Pantianicco (ETV)	Codroipo (UD)	—	5 BB	5	—
Rodaro, P. (e figli)	Spessa di Cividale (UD)	—	5 BB	30	—
Volpe Pasini, G.	Cividale (UD)	—	5 BB	10	—
Rauscedo (vivai di)	Rauscedo (PN)	R. 3	5 BB	30	—
Rauscedo (vivai di)	Rauscedo (PN)	R. 16	5 BB	60	—
Rauscedo (vivai di)	Rauscedo (PN)	R. 19	5 BB	50	—
Ist. Sper. Viticoltura	Conegliano (TV)	—	5 BB	10	—
Loredan	Venegazzù (TV)	—	5 BB	20	—
Loredan	Venegazzù (TV)	R. 3	5 BB	40	—
Molinelli	Ziano (PC)	—	3309	30	—
Vigevani	Rivergaro (PC)	—	5 BB	40	—
Paradiso (fattoria)	Bertinoro (FO)	—	SO 4	40	—
Paradiso (fattoria)	Bertinoro (FO)	—	420 A	20	—
Picolit nero:					
Tilatti, I.	Corno di Rosazzo (UD)	—	5 BB	90	+

+ = Colporated; — = Acolporated.

their productivity, provenance, rootstock and clone denomination when known. The pollen grains were always taken from mature anthers of flowers of main branches. Nearly all the biotypes belong to Picolit giallo, that is to grapevines bearing yellow grapes; only the Picolit of the farm Tilatti (see Table) has black grapes (Picolit nero).

Procedures of transmission and scanning electron microscopy (TEM, SEM) have been described earlier (Lombardo *et al.* 1976, 1978).

Results and discussion

All the examined pollen grains of Picolit giallo lack furrows and germinative pores (see Table). Therefore, it seems evident that the morphology of Picolit giallo pollen grains is not phenotypically modified by rootstock (see Table: Picolit Paradiso, rootstock SO 4 and 420 A), or provenance.

Regarding Picolit giallo, the type of clones seems without influence on the pollen morphology as well (see Table: Picolit Rauscedo, clones R. 3, R. 16, R. 19).

We observed evident furrows and germinative pores only in Picolit nero (Figs. 1 and 2), the unique biotype up to now known producing black grapes; this fact suggests that Picolit nero represents a cultivar undoubtedly separated from Picolit giallo; this, besides some morphological characters of the leaf, is also due to the above-mentioned pollen wall morphology.

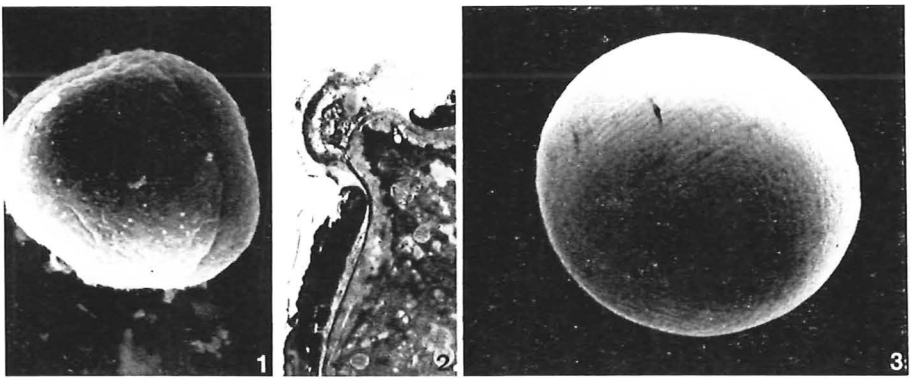

Fig. 1: SEM micrograph of a Picolit nero tricolporated pollen grain. Two furrows are clearly visible on its wall. × 2,500.

Fig. 2: TEM micrograph of a germinative pore of Picolit nero. The pollen wall provided with bacula and tegmen is interrupted forming a pore, from which a pollen tube takes rise. × 4,900.

Fig. 3: SEM micrograph of a pollen grain of Picolit giallo (Paradiso, rootstock 420 A). It is typically acolporated, without furrows and germinative pores. Besides, its sporopollenin wall is nearly smooth showing extremely reduced sculptures. × 4,300.

Abb. 1: SEM-Aufnahme eines dreifach gefurchten Pollenkorns der Sorte Picolit nero. Zwei Keimfurchen der Wand sind deutlich sichtbar. × 2.500.

Abb. 2: TEM-Aufnahme einer Keimpore der Sorte Picolit nero. Die Pollenwand mit Bacula und Tegmen wird durch die Pore, durch die ein Pollenschlauch austritt, unterbrochen. × 4.900.

Abb. 3: SEM-Aufnahme eines typisch acolporaten Pollenkorns der Sorte Picolit giallo (Paradiso, Unterlage 420 A) ohne Furchen und Poren. Die Sporopolleninwand ist außerdem nahezu glatt, die Skulpturierung weitgehend unterdrückt. × 4.300.

These observations confirm what was noticed in Razaki rosso HP. (LOMBARDO *et al.* 1978) and prove that the cultivars with colporated pollen grains are highly producing.

Moreover, we always observed the same kind of acolporated pollen, even if the fruit yield appears nearly normal (see Table: Picolit Marin 31 A.A., Picolit Nalon, Picolit Rauscedo R. 16).

In fact, while the presence of colporated pollen is always concomitant with high productivity (LOMBARDO *et al.* 1976 and 1978), the presence of acolporated pollen is only one of the most important factors that cause low productivity.

The exine of the pollen wall appears continuous, provided with bacula and tegmen; only in Picolit Paradiso, rootstock 420 A, the pollen wall exine shows extremely reduced sculptures (Fig. 3).

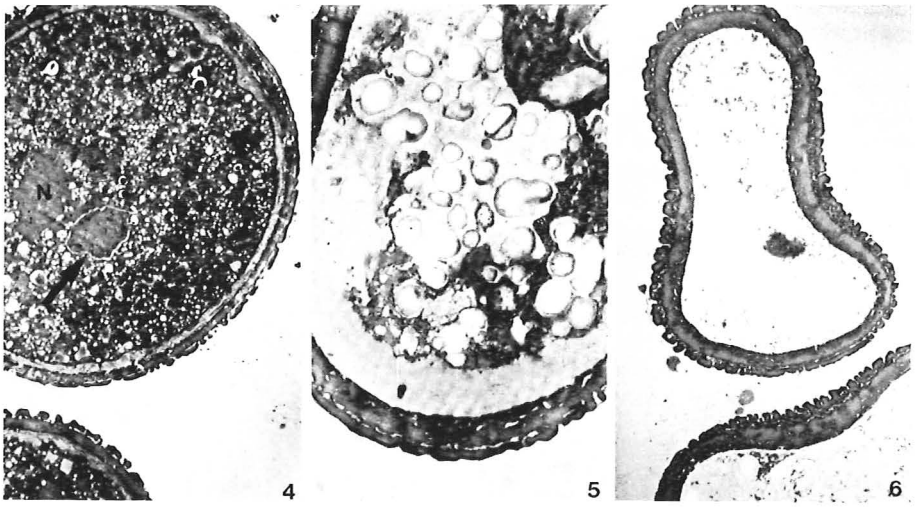

Fig. 4: TEM micrograph of a pollen grain of Picolit giallo (Nalon), showing a dense cytoplasm rich in cellular organelles. The vegetative nucles (N) is clearly visible and also the generative cell is well recognizable, bound by a fine callose layer (arrow). The pollen wall is continuous and of uniform thickness; the sporopollenin forms evident bacula and tegmen. × 2,800.

Fig. 5: TEM micrograph of a pollen grain of Picolit giallo (Badoglio), full of starch granulations. The cytoplasm appears degenerated. The sporopollenin wall is continuous with evident bacula and tegmen. × 5,300.

Fig. 6: TEM micrograph of pollen grains of Picolit giallo (Volpe Pasini). They appear quite empty, compressed, with a continuous sporopollenin wall provided with bacula and tegmen. × 2,700.

Abb. 4: TEM-Aufnahme eines Pollenkorns der Sorte Picolit giallo (Nalon). Das Cytoplasma ist dicht und enthält zahlreiche Organellen. Der vegetative Kern (N), ist deutlich sichtbar, ebenso die generative Zelle, die von einer dünnen Kalloseschicht umhüllt ist (Pfeil). Die Pollenwand ist nicht unterbrochen und gleichmäßig dick; das Sporopollenin bildet deutliche Bacula und ein Tegmen. × 2.800.

Abb. 5: TEM-Aufnahme eines Pollenkorns der Sorte Picolit giallo (Badoglio), von Stärkekörnern erfüllt. Das Cytoplasma wirkt zurückgebildet. Die Sporopolleninwand ist nicht unterbrochen und zeigt deutliche Bacula und ein Tegmen. × 5.300.

Abb. 6: TEM-Aufnahme von Pollenkörnern der Sorte Picolit giallo (Volpe Pasini). Sie erscheinen nahezu leer und eingedrückt. Die nicht unterbrochene Sporopolleninwand besitzt deutliche Bacula und ein Tegmen. × 2.700.

The intine forms an inner continuous and compact layer, uniformly thick all around the grain. This aspect differs from that of normal and tricolporated pollen of *Vitis*, whose intine forms lenticular thickenings under the three germinative pores.

While the external morphology of the pollen grains keeps unchanged in all the examined biotypes of Picolit giallo, remarkable differences have been observed on the pollen ultrastructure. Normally, in most of the examined biotypes the cytoplasm is dense and contains a great number of cellular organelles; the vegetative nucleus is clearly visible and also the generative cell is well recognizable, bound by a fine callose layer (Fig. 4). Contrary to these pollen grains by normal aspect, there are others with evident symptoms of degeneration. These last pollen grains appear quite empty (Fig. 6) or full of starch granulations (Fig. 5). Both normal and degenerated pollen grains can be present in the same anther in various percentages; it seems that a larger percentage of degenerated pollen grains is present in the biotypes with lower productivity. In fact, in Picolit Volpe Pasini, characterized by a very low productivity, the percentage of degenerated pollen grains is very high.

As we said above, since the pollen grains of Picolit giallo always lack furrows and pores, it seems very important that the stigmata of Picolit giallo flowers (physiologically male) could be pollinated by colporated pollen grains. Consequently, all those factors related with this pollination could influence the fruit yield of Picolit giallo more or less remarkably. Among these factors we must of course remind the stigmatic receptivity connected also with the life period of the female gametophyte (Carraro *et al.* 1979). Therefore, the importance of the distance and reciprocal position between Picolit giallo and grapevines with colporated pollen grains is evident, as well as the behaviour of the calyptra (we are still carrying out investigations about these problems).

We are also studying if pollen grains of Picolit giallo adhering to the stigmatic papillae could somehow act like "mentor pollen", promoting the germination of colporated pollen grains coming from other cultivars in reduced amount.

In fact, as said above, Picolit biotypes, with anthers quite empty or containing a high percentage of degenerated pollen grains, show an extremely reduced productivity (see Table : Picolit Volpe Pasini and Picolit Nalon).

Summary

Pollen grains of several biotypes of Picolit giallo, cultivated in different regions, have been studied by scanning and transmission electron microscopy.

Picolit giallo pollen grains appear acolporated (without furrows and germinative pores) in all the examined biotypes. Therefore, the absence of pores seems to be a genetic character, independent of rootstock productivity and provenance.

Contrary to Picolit giallo pollen grains, those of Picolit nero (a cultivar with high productivity) are tricolporated and consequently similar to pollen grains of *Vitis* cultivars with normal productivity.

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