

Localization of allergenic molecules in pollen grains

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Abstract. The wall of the mature pollen grain contains several layers, of which the outermost, the exine, is formed by the mother plant. Numerous proteins are incorporated in the exine. During the normal germination process on the stigma, these proteins interact with the stigmatic proteins. The interaction results into either enhancement or cessation of the pollen tube growth. It has been shown that most of these proteins diffuse into surrounding solutions already in a few seconds. They also cause allergic reactions in man. The diffusion of proteins and their allergic properties are not dependent on the germination of the pollen grains, and probably not either on their viability. The pollen grains of conifers are very weak allergens; their structure and function are different from those of the remaining flowering plants.

The pollen grains effect the transfer of the male genes to the ovary of the female flower organs. Rich in enzymes and other proteins, they are an important cause of respiratory allergies in man. To understand the nature of these allergenic reactions, we should become familiar with the morphology and function of the pollen grain.

1. STRUCTURE OF THE POLLEN GRAIN

The pollen grain is formed by only one

cell, it has one nucleus, and an elaborately constructed wall. This tiny plant includes one generative cell as a male sexual organ. This male cell, with a huge nucleus, will take care of the fertilization of the female egg cell. Pollen grain, as naturally also the egg cell, is haploid.

The wall of the pollen grain includes numerous layers; only the gross morphology is given here (Fig. 2). The innermost layer is called intine; it is formed by the haploid pollen grain itself. The outer layer, exine, is composed by several sub-layers, here omit-

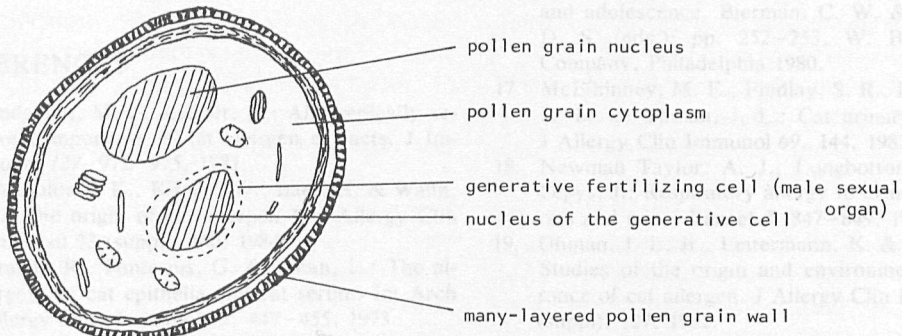


Fig. 1. Main structure of the pollen grain of an angiospermous plant. Diameter ca. 30 μm .

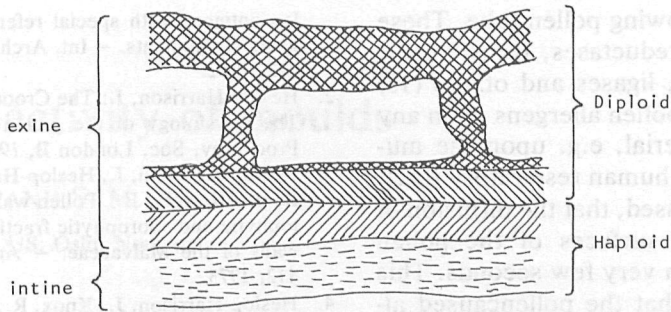


Fig. 2. The gross morphology of the pollen grain wall. The main wall material is sporopollenin. Diploid = formed by the diploid mother plant. Haploid = formed by the haploid pollen grain.

ted. He innermost part of the exine is formed by the haploid pollen grain, but the outermost layers by the diploid mother plant. Various layers of the exine may thus have a different biochemical composition.

The main wall material is sporopollenin, which is actually the most resistant organic substance produced by living organisms. Both the cavities formed by the exine, and the rest of the wall layers show a high activity for various proteins and lipids, enzyme proteins included (Heslop-Harrison 1975).

2. POLLINATION AND FERTILIZATION

Pollination means the transfer of the pollen grain from the anther to the pistil. This takes place either by insects or by wind (Fig. 3). On the female stigma the pollen grain germinates, and the fertilizing cell moves to the egg cell through the pollen tube which grows through the style down to the ovary (Fig. 4).

3. ROLE OF ENZYMES AND OTHER PROTEINS

It is very obvious (1, 10, 14) that the reactions between the pollen tube and the stylar tissue are immunological. Various enzymic proteins (11), located in the structures of the pollen grain wall, begin to diffuse readily into any surrounding solution in a very

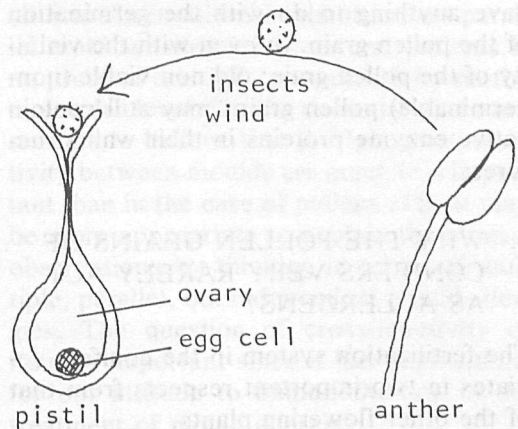


Fig. 3. In the pollination the pollen grain is carried to the pistil either by insects or by wind.

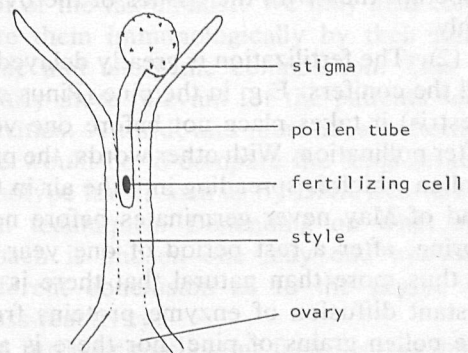


Fig. 4. Fertilization:
Growth of the pollen tube through the style.

short time, practically immediately (3, 4, 5, 6, 7, 8, 9, 13). These act in plant upon the stylar tissue, which actually supplies nour-

ishment for the growing pollen tube. These enzymes — oxidoreductases, transferases, hydrolases, lyases, ligases and others (13) — also may act as pollen allergens upon any other organic material, e.g. upon the mucous tissues of the human respiratory tract.

It should be stressed, that the diffusion of proteins from the surfaces of the pollen grain takes place in very few seconds. This explains the fact that the pollen-caused allergic reactions may be very sudden, and occasionally also very severe. It should be further noted that the diffusion is a purely physical phenomenon. It does not need to have anything to do with the germination of the pollen grain, or even with the viability of the pollen grain: old non-viable (non-germinable) pollen grains may still contain active enzyme proteins in their wall structures.

4. WHY THE POLLEN GRAINS OF CONIFERS VERY RARELY ACT AS ALLERGENS?

The fertilization system in the conifers deviates in two important respects from that of the other flowering plants.

(1) There are no stigmas or styles in the female organs. The reactions of the pollen tube are thus with the tissues of the ovary only.

(2) The fertilization is greatly delayed in all the conifers. E.g. in the pine (*Pinus sylvestris*) it takes place not before one year after pollination. With other words, the pine pollen which is spreading into the air in the end of May never germinates before next spring, after a rest period of one year. It is thus more than natural that there is no instant diffusion of enzyme proteins from the pollen grains of pine, nor there is any allergenic activity.

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