Development of the Generative Cell Wall in
Monotropa uniflora L. Pollen

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ABSTRACT

During an ultrastructural survey of an achlorophyllus dicotyledonous plant, Monotropa uniflora L., a stage of pollen development was encountered which suggests a relationship between the activity of the rough endoplasmic reticulum and the development of the generative cell wall.

Pollen ontogeny has been studied in a number of different plant species (2, 3, 4, 11), and the existence of a generative cell wall, though once doubted, has been verified (9). While the course of events by which the generative cell wall isolates the generative cell from the vegetative (tube) cell has been documented (1), the structures responsible for the synthesis of the generative cell wall have not been identified. It is the purpose of this short note to propose that the generative cell wall in Monotropa uniflora L. pollen is at least in part derived from ribosome-bound vesicles derived from rough endoplasmic reticulum.

MATERIALS AND METHODS

Complete plants were collected from local populations of M. uniflora L., and an ultrastructural survey was undertaken, part of which has been reported elsewhere (8). Anthers from such plants were fixed at room temperature in Karnovsky’s fixative (7). Cuts were introduced into the anthers to facilitate penetration. After degassing in fixative, the tissues were postfixixed with osmium tetroxide, dehydrated in a graded ethanol series, and embedded in Spurr’s plastic (12). Sections were cut to 600 A in thickness with a diamond knife, stained with 10% aqueous uranyl acetate and Fafnyh’s lead citrate (4), then observed with a Zeiss EM 9A microscope.

RESULTS AND DISCUSSION

The earliest stages of generative cell wall formation have been described for massulate orchids (6) and Endymion non-sevinitus L. (1) as similar to the formation of a cell plate after a mitotic division. These earliest stages of wall formation were not available in the present study.

Angold (1) observed in Endymion that during the time of generative cell wall formation there was a period of intense RER activity. Such a period was also encountered in the nearly mature microspores of M. uniflora L. A representative micrograph of such microspores is presented in Figure 1. Two nuclei are apparent: the generative nucleus in the generative cell and the tube nucleus in the vegetative (tube) cell. The vegetative cell is partitioned from the generative cell by the generative cell wall. Two of the normally three pollen tube pores are present. Moderate amounts of RER cisternae and associated vesicles are visible. These are often seen in close proximity to the intine, frequently near the pollen tube pores, and also near the generative cell wall. They may be found on either side of the cell wall. Peak RER activity is not illustrated in Figure 1. In some sections regions of RER up to 45 cisternae in thickness have been encountered. In some cases the lengths of the cisternae were observed to be approximately one-fourth the diameter of the microspore. A section demonstrating greater RER activity (Fig. 2) shows dilated RER closely associated with the intine and the generative cell wall. The single nucleus present in this section is the generative nucleus, and the course of the generative cell wall is indicated by arrows. Micrographs of the same section at higher magnification reveal ribosome-bound vesicles which appear to be fusing with the generative cell wall (Figs. 3 and 4). In some sections vesicles were found which seemed to be fusing with the intine, but these were not ribosome-bound and did not seem associated with any particular organelle. Dictyosomes which have been shown to be involved in intine deposition in other plant species (5) were present but infrequent in our material. Other organelle inclusions found in the pollen of M. uniflora L. have been described elsewhere (10).

The present data suggest that the generative cell wall, a hemispherical structure which is at least during part of its development continuous with the intine, owes some portion of its substance to the activity of the RER. Evidence that the RER also contributes to the development of the intine or the pollen tube pores in M. uniflora L. is presently lacking. The resolution of such a proposal must await a developmental study of Monotropa microspores.

LITERATURE CITED


1 Abbreviation: RER: rough endoplasmic reticulum.
FIG. 1. Binucleate microspore showing both the tube nucleus (tn) and the generative nucleus (gn). The course of the generative cell wall (gcw) which fuses with the incomplete intine (i) is indicated by arrows. Fields of vesicles dilated rough endoplasmic reticulum (rer), and two of the three pollen tube pores (ptp) are also visible.

FIG. 2. Microspore showing only the generative nucleus (gn). The location of the generative cell wall is indicated by arrows. Note that diluted RER tends to be located near the intine or the generative cell wall.

FIGS. 3 AND 4. Show ribosome-bound vesicles (arrow) which appear to be continuous with the generative cell wall (gcw).