ANOMALOUS STRUCTURES IN THE BORDERED PITS OF FIBER-TRACHEIDS OF *RIBES SANGUINEUM*

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ABSTRACT

The presence of padlike structures in the pit chamber of fiber-tracheids of *Ribes sanguineum* has been described and illustrated. The possibility of their protective function for the pit membrane is discussed.

Additional keywords: Wood structure, ontogeny, ultrastructure.

During an investigation of the development and fine structure of septate fiber-tracheids in the xylem of *Ribes sanguineum* (Parameswaran and Liese 1969), certain unusual features were observed within the pit chamber, which are described in the following.[1]

The secondary xylem of Ribes is composed of vessels, parenchyma cells, and fiber-tracheids; about 90% of the fiber-tracheids are septate. As has been pointed out in the paper cited above, most of the fiber-tracheids remain alive till late stages and become septate; some of the cells lose their cytoplasm in the course of ontogeny and function as mechanical elements.

Within the youngest three to six rows of fiber-tracheids, padlike structures within the pit chambers are present (Figs. 1–6). In cross sections the pads appear like crescent-shaped plates on both sides of the pit membrane. The tapered ends of the pads lie in a depression near the annulus without direct contact with the cell wall. Their occurrence is strictly confined to fiber-tracheids. A half-bordered pit-pair between a fiber-tracheid and a parenchyma cell exhibits the pads only on the fiber-tracheid side, whereas the parenchyma side is provided with a protective layer (Figs. 1, 2). Similarly the pit between a fiber-tracheid and a vessel member possesses the pad only on the fiber-tracheid side. In large pads filling the pit chamber, plasmodesmata or remnants of them are often present; these appear to be continuations of those in the pit membrane (Fig. 1). This applies particularly to pits between fiber-tracheids and parenchyma cells, the former still with living protoplasts. Thus the padlike structures seem to exist from the very early stages of pit ontogeny.

In the fifth or sixth cell layer from the cambium, the pads evince a gradual disintegration leading to final disappearance. This is mostly initiated in the middle part of the pads and proceeds towards the tapering ends, so that at some stages the remnants of pads are present only at the ends of the pit membrane. Some stages of this disintegration process are shown in Figs. 2–6. The examination of numerous micrographs leads to the assumption of a hydrolysis resulting in a dissolution of noncellulosic polysaccharides (cf. O'Brien 1970). Evidence for this supposition could be seen in some of the observed cases where the pads and the matrix substances from the pit membrane show signs of dissolution either at the same time or in sequence; the pit membrane is thereafter composed only of a mat of cellulose fibrils.

The chemical nature of these padlike structures is still unknown; ultraviolet spectra in the region of pad occurrence gave no indication of the presence of lignin. Their contrast in electron micrographs when compared with the cell wall and the process of degradation underline the

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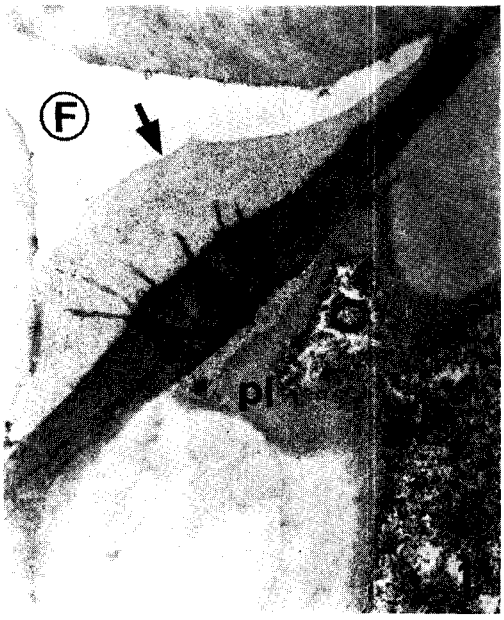

FIG. 1. Pad (arrow) on the fiber-tracheid side (F) and protective layer (pl) on the parenchyma side (P) of the pit membrane. Plasmodesmata in pit membrane and pad. 22,400 ×.

FIG. 3. Pads filling the pit chambers of fiber-tracheids; the pit membrane is being hydrolyzed. 16,800 ×.

FIG. 2. Dissolution of pad on the fiber-tracheid side (F). 22,400 ×.

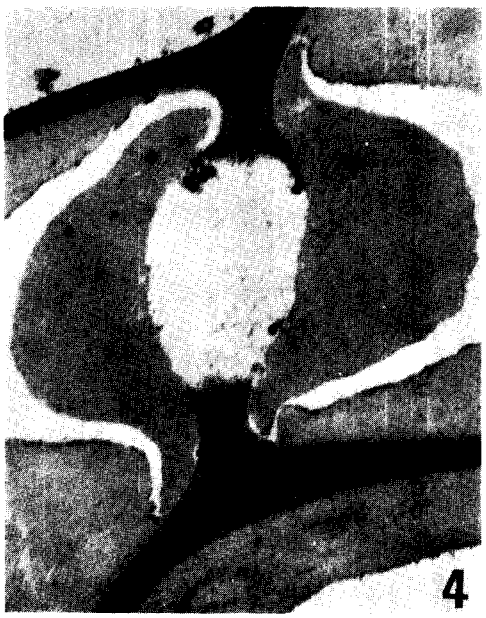

FIG. 4. Pit membrane between fiber-tracheids consisting of a mat of fibrils. 22,400 ×.

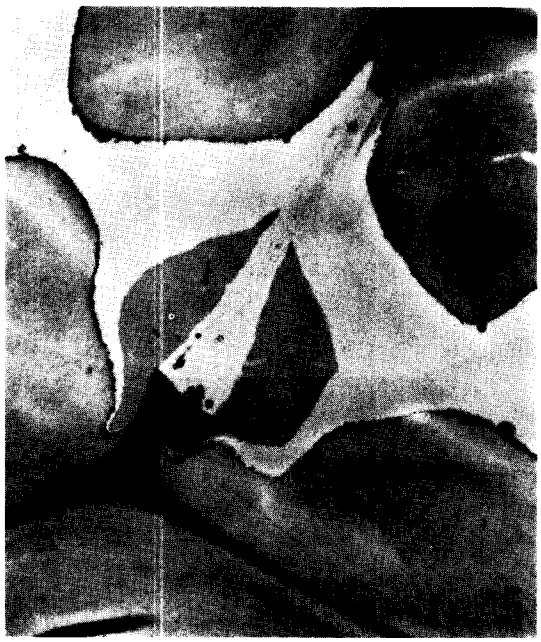

FIG. 5. Remnants of pads in process of disintegration. 12,880 ×.

FIG. 6. Stages of disintegration of pads; bottom fiber-tracheid with a strongly reduced stipulelike structure (arrow). 8,260 ×.

absence of lignin. Histochemical tests have not yet been performed because of the difficulty of resolving them in the light microscope. The retention of the cellulosic fibrils in the pit membrane after hydrolysis and the complete dissolution of the pads seem to negate the presence of cellulose in these structures.

To our knowledge this is the first observation of such padlike structures in bordered pits. In the ontogenical studies on the pits of gymnosperms and angiosperms in recent years, no such features have been noted (cf. Cronshaw and Bouck 1965; Fengel 1966; Schmid and Machado 1968; Murmanis and Sachs 1969). No definite conclusions about the origin and function can be drawn on the grounds of present observations. However, some aspects may be considered that might serve for further elaboration.

The structures observed in Ribes seem to be confined to nonseptate fiber tracheids; this is established on the basis of protoplast degeneration in these in contrast to other cells, which are destined to become septate. In conjunction with the process of protoplast degradation, there occurs a hydrolysis removing the padlike structures. At this stage the pit membrane that has been entrapped between the pads may also get exposed to the hydrolyzing enzymes. On the basis of the observation of an almost complete removal of the pads in the course of cell differentiation, one is led to look for a function for these during the early phases of ontogeny. Whether this function is of a protective nature, just as the protective layer of parenchyma cells adjacent to vessel members (Schmid 1965, Meyer and Côté 1968), is an open question; the latter is, however, a permanent feature in contrast to the pads.

More information must be forthcoming on the development and chemical composition of these structures as well as on their presence in other species before the functional aspects can be discussed. These observations are presented here to stimulate remarks and further studies.

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