

Cuticle of Maize (*Zea mays* L.) Anther

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The outer surfaces of terrestrial plants are covered by a continuous, water-resistant cuticular membrane which exhibits considerable variation in structural and chemical composition. Traditionally, it has been interpreted as consisting of an outer layer of epicuticular wax; a narrow, homogeneous cuticularized layer; and a thicker, reticular, cutinized layer. In addition to the six different structural types classified for cuticle^[1], a ridged or rugose cuticles (FIG 1 and 2) type was reported from a variety of sources, including sorghum, maize, oats and rice^[2, 3], and tomato^[4]. Increasingly, ridged cuticles are reported as covering epidermal cells from a wide variety of sources. The most commonly studied location is on the anthers of grasses. In maize, in addition to being present on anther surfaces, ridged cuticles occur over bulliform cells and subsidiary cells and on the cells surrounding some hairs. The ridged cuticle frequently found on the surface of cells which undergo volumetric changes, therefore, it was suggested that the ridged cuticle on the anther surface of maize may be responsible for/response to water removal during anther dehiscence. However, a non-dehiscent mutant (*ndh/ndh*) recently discovered by one of the authors (DBW) develop anthers resemble to those of normal maize including the ridged cuticle^[6]. Our preliminary data suggested that the removal of water during dehiscence may involves active transport of water away from anther. FIG 1 and 2 reveal that the cuticular ridges are aligned predominantly in the longitudinal axis of the epidermal cells (E) but as well run between adjacent cells and are continuous between cells. The ridges persist in cuticles removed intact from mature anthers by HCl-ZnCl₂ treatment^[3]. The mature structure of the cuticle, as revealed in cross-sectional TEM views (FIG 3), appear to be permanent, persisting even when the layer is removed from the wall (FIG 4). Electron-dense fiber-like structures penetrate the reticulum and fill the narrow cavity within the ridges. The fibrous materials are continuous with the cell wall. Metal shadowing technique reveal detailed surface structures on the isolated cuticles of mature anther (FIG 5, inner surface). In order to study the volumetric and structural changes during anther dehiscence, optical microscopy of various modalities is currently under consideration. Optical sections obtained by fluorescent confocal microscopy provide possibility of three-dimensional reconstruction the epidermal (E) and endothecium (En) layer of the mature anther (FIG 6 and 7). For living tissue, confocal microscopy operated in back scattered mode can be used to study the surface of the anther cuticle^[6]. In addition, we have found that, on rice leaf, second harmonic (SHG) and third harmonic (THG) signals can be detected from the cuticle-wall complex and the surface of the cuticle respectively. Therefore, it is possible to utilize these non-linear imaging tools to gain insight on the mechanism of anther dehiscence and the possible involvement of the cuticle in this important process.

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FIG.1. SEM image of ridged cuticle on the surface of the anterior end of a maize anther.

FIG.2. SEM image of ridge cuticle reveals most of the ridges are parallel to the long axis of the cells.

FIG 3. TEM image of a ridged cuticle (c) and cell wall (w). E: epidermal cell.

FIG 4. TEM micrograph of an isolated cuticle showing ridges remain after HCl-ZnCl₂ treatment.

FIG 5. Metal replica of the inner surface of an isolated cuticle. Note the inner view of the base of a ridge (R). The fine surface bumps are chloroform-extractable and possible wax in nature^[3].

FIG 6. Fluorescent confocal optical section of the anterior end of an anther. Arrows: cuticular ridges; E: epidermal cell; En: endothecium cell. (anther obtain from *ts4/ts4* (tassel seed) plant)

FIG.7. Confocal image of the auto-fluorescing ridged cuticle. Arrows: cuticular ridges.

