MEMBRANE DYNAMICS DURING FIBER DEVELOPMENT: AN ULTRASTRUCTURAL ANALYSIS

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Abstract

The mechanism by which cotton fibers produce and deposit secondary cell wall has remained unclear due the difficulty of adequately preserving ultrastructural detail in fibers with thick cell walls. The application of rapid freeze-freeze substitution techniques to Acala SJ-1, 30 DPA (days post anthesis) fibers resulted in superb preservation of cytoplasmic detail. The cytoplasm is rich in ribosomes and organelles such as Golgi bodies, endopasmic reticulum and mitochondria. Both the plasmalemma and tonoplast membrane were well preserved. The plasmalemma appeared tightly oppressed to the cell wall. Numerous vesicles were detected fusing with or in close proximity to the plasmalemma, indicating that the cell is actively producing are recycling wall and membrane components. This activity may indicate turnover of cellulose synthetic machinery, thus suggesting that cellulose synthases may have a short half-life in the cotton fiber. Some of the vesicles were coated with clathrin, indicating a regulated pathway for membrane secretion or recycling. The lack of any evidence of vesicle fusion to the tonoplast shows that the vacuole in no longer expanding. In all cells examined, the plasmalemma exhibited infoldings into the cytoplasm. The quality of preservation of the cytoplasm, tonoplast and plasmalemma reduces the likelihood that these infoldings are artifacts. If the cell is actively adding new membrane to the plasmalemma (as indicated by the numerous vesicles fusion's) and the cell is not expanding (as indicated by the lack of vesicle fusion with the tonoplast and the presence of a thick cell wall), then these membrane infolding may be a mechanism for dealing with excess membrane inserted into the plasmalemma. Further analysis, detailing the development and extent of these infoldings will be done to test this possibility. This work was supported by grants from Cotton Incorporated, Raleigh NC to RWS and CHH.

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