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Cell wall formation in root hairs and the influence of heavy metals

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Root hairs are long tubular cells with unidirectional growth; cell wall formation is restricted to their tips and depends on the coordination of numerous molecular and cellular processes including exocytosis of pectins, endocytosis of excess plasma membrane, cellulose synthesis and the turgor pressure of the vacuole. They increase the root surface tremendously and serve as contact between plant and soil in order to improve nutrient uptake.

Exo-/endocytotic vesicles are too small to be resolved by conventional light microscopy, wherefore the tip region of root hairs is usually called “clear zone”; they become visible only in electron micrographs. Visualizing their dynamic behaviour and their coordination with the cytoskeleton is however needed in order to understand the underlying principles of signaling and growth regulation. We therefore applied video-enhanced contrast light microscopy and ultraviolet microscopy and thus were able to visualize these vesicles in their living state and to analyze their movements. Staining of the plasma membrane with fluorescent dyes yielded information about the dynamics of exo- and endocytotic processes during cell wall secretion and membrane recycling.

We investigated the influence of heavy metals, especially of zinc, on structure and growth of root hairs of *Triticum aestivum*, spring wheat. In addition, we analysed the absorption and transport of zinc into roots and root hairs by using fluorescent tracer dyes specific for heavy metals. We compared the results from fluorescence with data from the scanning electron microscope where we used energy-dispersive X-ray spectroscopy (EDX) in order to localize heavy metals.

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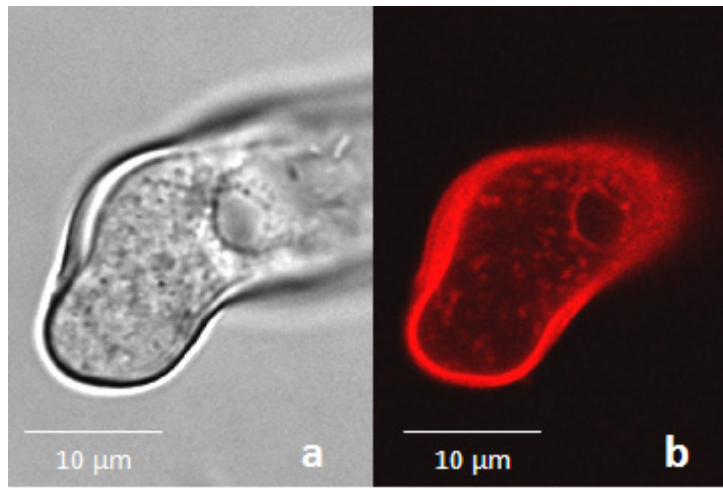


Fig. 1: Tip of growing root hair after zinc treatment, showing abnormal cell wall thickening. a: vesicles in the clear zone in the bright-field after contrast-enhancement by video techniques. b: plasma membrane and endosomes in FM4-64.

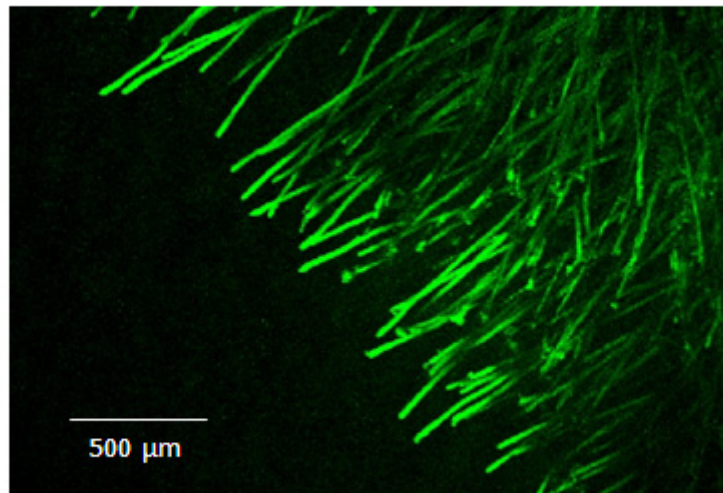


Fig. 2: Root hairs after staining with Newport Green, a fluorescence tracer dye specific for heavy metals such as zinc.