On the Regulation of Vacuolar Size and its Impact on Cellular Elongation

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Vacuoles have multiple functions in plants, such as the lytic degradation of proteins, sequester metabolites and cellular osmoregulation. Additionally, vacuole expansion play a central role in cell size regulation in plants. During cell elongation, vacuolar occupancy increases proportionally to cell size, while cytosol volume remains relatively constant. Vacuoles allow plant cells to quickly multiply their volume without massive de-novo synthesis of cytosolic components. Our data indicates that vacuole enlargement during cell elongation is regulated by auxin and require enhanced vesicle trafficking towards the tonoplast. My aim is to identify and characterize molecular players involved in the regulation of vesicle trafficking towards the vacuole during cellular elongation and to address their role in cellular elongation.

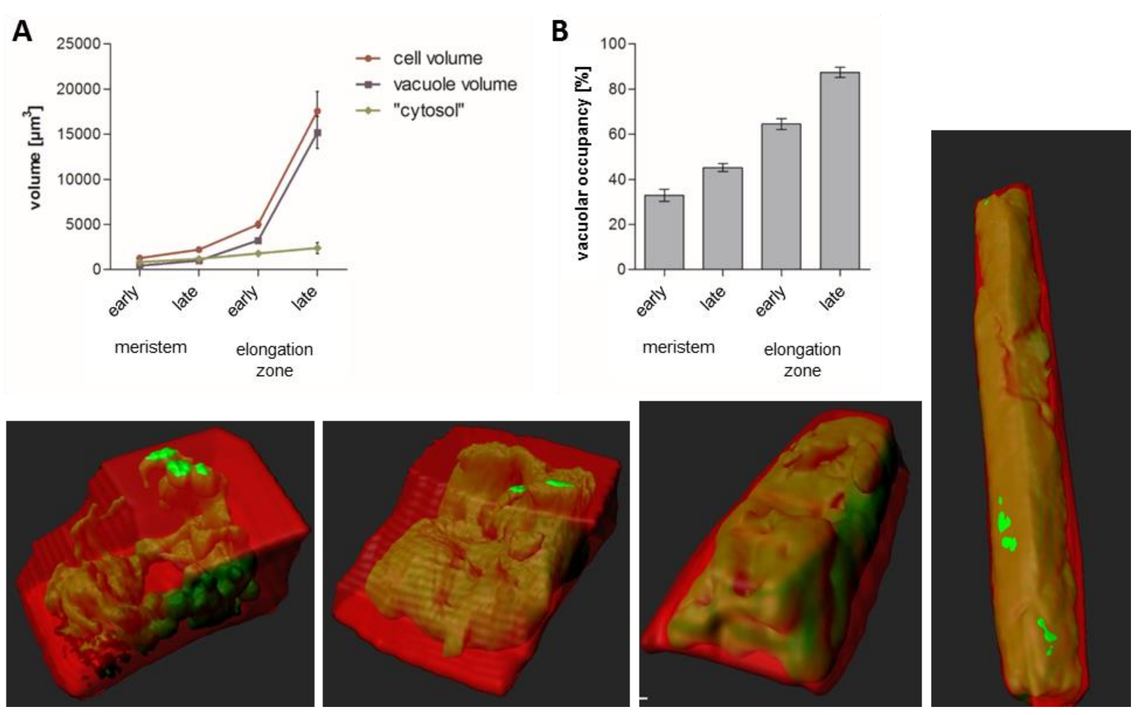

Figure 1: The relative vacuolar occupancy increases during cellular elongation, while the cytosol content remains relatively stable. The vacuole-mediated cytosol homeostasis allows cells to multiply their volume without massive de-novo synthesis of cytosolic components.

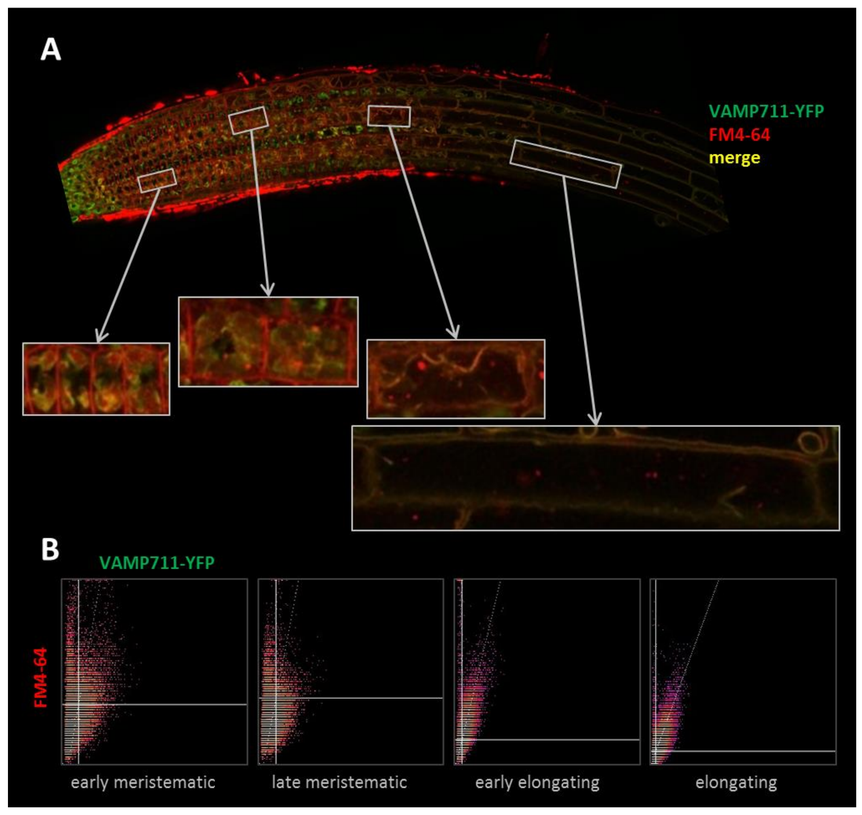

Figure 2: The tonoplast marker VAMP711-YFP and the membrane dye FM4-64 colocalize more readily in early elongating cells compared to meristematic cells. This observation indicates that intracellular vesicle trafficking towards the vacuoles is increased during cellular elongation.

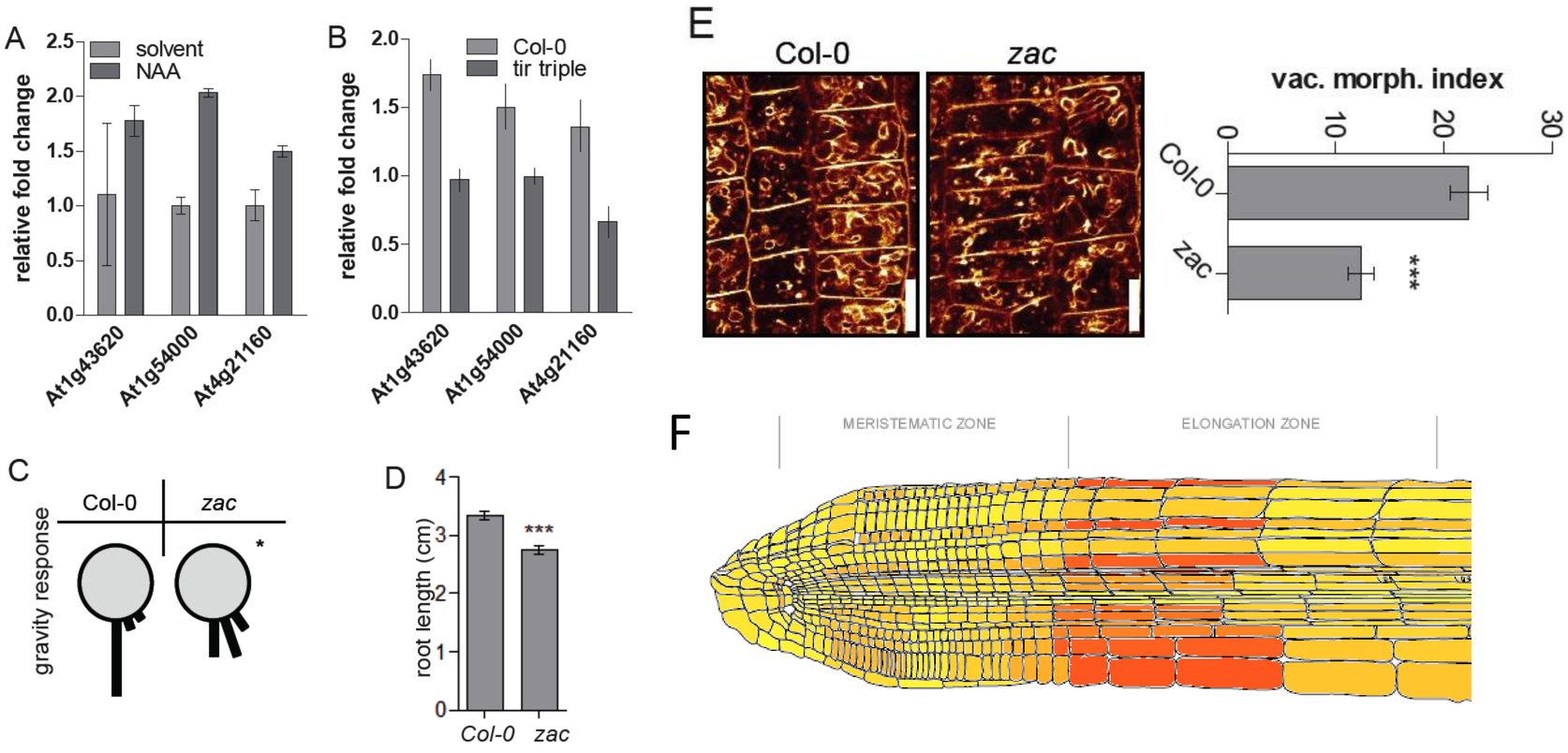

Figure 3: ZAC is a potential regulator of vacuolar morphogenesis. The *zac* knockout mutant showed altered vacuolar morphology, reduced root length and defects in gravitropic growth. *ZAC* is involved in ARF-dependent vesicle trafficking. Moreover it is presumably expressed in the root elongation zone, which might allow ZAC to ensure delivery of new membranes to the vacuole during cellular elongation.

Outlook: Part of my proposed project is to address whether ZAC is directly involved in the regulation of vacuolar size and subsequently in cellular elongation. In addition, I will identify vacuolar associated proteins, which are under transcriptional control of the phytohormone auxin. The ultimate goal will be to unravel the mechanistic contribution of the respective candidates to changes in vacuolar occupancy and subsequent root growth regulation. Altogether, this work will very likely unravel novel components involved in vacuolar morphogenesis and the control of root growth.

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