Signal transduction in *Phycomyces* sporangiophores: columella as a novel sensory organelle mediating auxin-modulated growth rate and membrane potential

Abstract

The growing zone (GZ) of the unicellular coenocytic sporangiophore of *Phycomyces blakesleeanus* represents the site of stimulus reception (light, gravity, gas) and stimulus response, i.e., local modulations of the elongation growth, which may result, in dependence of the stimulus direction, in tropic bending. Until now, evidence for a possible participation of the columella in sensory reception is absent. We confirm with light microscopy earlier studies that show that the GZ and the columella are not separated by a membrane or cell wall, but rather form a spatial continuum that allows free exchange of cytoplasm and organelle transport. Evidence is presented that the columella is responsive to external stimuli. Columellae, from which spores and sporangial cell wall had been removed, respond to exogenous auxin with a local depolarization of the membrane potential and an increased growth rate of the GZ. In contrast, auxin applied to the GZ causes a decrease of the growth rate irrespective of the presence or absence of sporangia. The response pattern is specific and relevant for the sensory reception of *Phycomyces*, because the light-insensitive mutant C148*carAmadC*, which lacks the RAS-GAP protein MADC, displays abnormal IAA sensitivity and membrane depolarization. We argue that the traditional concept of the GZ as the only stimulus-sensitive zone should be abandoned in favor of a model in which GZ and columella operate as a single entity capable to orchestrate a multitude of stimulus inputs, including auxin, to modulate the membrane potential and elongation growth of the GZ.