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Introduction

C. Brownlee and D. Sanders

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Introduction

Ion fluxes through membrane channels are involved in many basic plant cell functions, including nutrient uptake, photosynthesis, respiration and responses to environmental changes. Plants exhibit a multiplicity of responses to a diverse range of signals. The sedentary habit of most plants has resulted in the evolution of many response patterns based largely on adaptation rather than attraction or avoidance. Accordingly, it is becoming clear that signal–response coupling mechanisms in plant cells, while showing many similarities with animal counterparts, also differ in a variety of respects. Plasma membrane ion fluxes are now known to be involved in the early detection of many signals by plant cells, including hormonal, light, gravity, temperature, mechanical and osmotic changes. Responses, including altered turgor, growth, morphogenesis and metabolic changes also frequently involve altered ion fluxes across the plasma membrane. Less is currently known of the role of plant endomembranes such as the endoplasmic reticulum in signal–response coupling. The presence of a large vacuole in most plant cells presents an additional compartment and membrane across which fluxes of regulatory ions can occur.

There is now increasing awareness of the role of Ca^{2+} as a second messenger and regulator of many plant cell processes, including ion channel activity. This theme issue presents a broad view of our current knowledge of the properties of calcium-selective channels in plant cell membranes and their roles in signal transduction and regulation. In addition, examples have been chosen to highlight aspects of the regulation by Ca^{2+} of different cell functions via modulation of ion transport through different channel types.

This field is at an early stage of development. The application of modern cell biological techniques, including patch clamping and the construction of transgenic plants, should see a rapid expansion of our knowledge of ion channel function and regulation, leading to a better understanding of the mechanisms underlying the coordination of plant cell activities.

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C. Brownlee
D. Sanders