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EDITORIAL

Dynamics and mechanics of plant cell walls: insights into plant growth, defence, and stress response

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Walls are essential for plant cells: they provide physical support, define the shape and volume of cells and are the interphase between two neighbour cells, thus also determining cell communication and transport. Moreover, they are the first barrier against pathogen infection, playing both active and passive roles in plant defence and their biophysical properties regulate plant morphogenesis. The variety of roles of plant cell walls is greatly dependent on their highly dynamic biochemical composition, architecture and mechanical characteristics. Over the last 30 years, studies of the plant cell wall have evolved from those aimed at understanding its composition and structure, which led to the establishment of the first models of wall types, to studies addressed to unveil its biosynthesis and modification thanks to the availability of new tools such as molecular biology and genome sequencing. However, in the last period, this field has experienced a great advance due to the incorporation of numerous researchers from other fields, who sooner or later have ended up finding that the mechanism they are studying is somehow mediated by the cell wall. The current transition of the plant cell wall community from pioneer studies to those more related to plant functionality is reflected in the 6 articles in this special issue.

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This is clearly reflected in the first two articles of this special issue, in which processes as important for plants as stomatal movement and tissue regeneration after injury are studied using mainly immunohistochemical techniques aimed at understanding the distribution of specific cell wall components of species of agronomic interest such as maize and tomato. In the first article, Gkolemis et al. (2023) observe spatiotemporal changes in the distribution of cell wall matrix materials during stomatal function. In particular, their images show a clear differentiation in the distribution of homogalacturonan with different degrees of methylesterification and hemicelluloses in different regions of the stomata cells. The participation of the above cell wall matrix polysaccharides in the well-orchestrated response of the cell wall during the reversible movements of the stomatal complexes is discussed by the authors. In the second one, Frey et al. (2023) immunolocalized changes in the major cell wall matrix components of autograft union tissues throughout the course of healing after grafting in tomato. In this case, again the pectic polysaccharide homogalacturonan, and its degree of methylation, was shown to play a key role in the process, as it is *de novo* synthetized and deposited in the cut edges. Another pectic polysaccharide relevant for the graft success is rhamnogalacturonan and in particular its galactan side chains. The combination of these and other changes in hemicellulosic cell wall components appears to be related to the success of the autograft, specifically facilitating the adhesion phase between scion-rootstock tissues. These studies illustrate how specific cell wall components play crucial roles in vital plant functions.

A key concept that has emerged with enormous force in this scientific field is the concept of cell wall integrity (CWI). This term, first described in yeast, encompasses numerous plant physiological responses mediated by changes in cell wall structure. This concept and its interplay with cell cycle progression in plants has been reviewed by Soni and Bacete (2023). The review explores how CWI influences cell cycle activity, drawing on insights from yeast and mammals to uncover regulatory pathways in plants. It discusses the molecular links between CWI changes and cell cycle control, emphasizing the potential implications for crop improvement and sustainable agriculture. This perspective underscores the importance of CWI, linking it to plant growth and response mechanisms, thereby expanding our understanding of plant physiology.

The highly dynamic nature of the plant cell wall, together with its continuous surveillance by the CWI monitoring system, reaffirms the long-held belief that this structure plays a prominent role in pathogen-plant interactions. This role extends beyond serving as a mere structural barrier to being an active participant in these interactions. One of these aspects, widely studied in recent years, is its role as a source of elicitors perceived by specific receptors anchored to the plasma membrane. The perception of these molecules triggers the first line of innate immunity in plants, known as pattern-induced immunity (PTI), thus certain cell wall-derived oligosaccharides are classified as Damage-Associated Molecular Patterns (DAMPs). Hence, in another of the articles in this special issue, Dewangan et al. (2023) described the xylose disaccharide as a novel cell wall-derived DAMP that triggers PTI responses, alters cell wall polysaccharide composition and influences growth hormone levels in Arabidopsis. Given that the use of DAMPs could be applied in the development of new biosolutions for crop production, it is also worth highlighting the work of Rebaque et al. (2023), in which they propose a new technical development to obtain them. In this work, subcritical water extraction of *Equisetum arvense* cell wall generated glycan-enriched fractions that contain DAMPs that triggered plant immune responses and disease resistance. The results shown indicate that this technology could be very effective for the revalorisation of different plant residues through the extraction of possible immunostimulants contained in them by using pressurised hot water. These works highlight the complexity and importance of cell wall components in plant health.

Finally, another role of the plant cell wall studied in this special issue is its role in modulating abiotic stresses. In this case, Ali et al. (2023) studied a putative connection between cadmium stress and cell wall lignin content. By using an elegant genetic approach, these authors found that a specific miRNA, miR397, could modulate cadmium tolerance in plants by regulating the expression of several laccases, changing the lignin content, which may play an important role in inducing different stress-tolerant mechanisms and protecting the cell from a hazardous condition. This study connects cell wall composition with plant stress tolerance, suggesting new avenues for enhancing plant resilience against environmental challenges.

As these articles demonstrate, the plant cell wall continues to be a critical and evolving area of research, opening interesting and novel lines of research. However, research in this field faces the challenge of developing new technologies that allow detailed *in muro* studies. Finally, the editors of this special issue of Plant Molecular Biology would like to thank all the authors for their valuable contributions, as well as the staff of the journal for their support, and we hope that readers will enjoy these articles as much as we have.

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