Cell biology: Editorial overview.

Rosy Franco*

Managing Editor, Journal of Cell Biology and Metabolism, United States

Accepted June 25, 2021

The ability of cells to coordinate proliferation, differentiation, and physiological programming in response to both endogenous and external inputs is a characteristic of multicellularity. Plants use signalling pathways that act on multiple scales to achieve coordination, ranging from intracellular communication among organelles or cellular compartments to maintain metabolic homeostasis to long-distance molecular transport across plant tissues to synchronise developmental programmes and stress responses. We asked established scientists and pioneering early-career investigators to share updates and insights on the molecular and cellular mechanisms underlying signal transduction in plants for this issue of Current Opinion in Plant Biology. We specifically asked these scientists to discuss their most recent studies into intra-cellular and inter-cellular trafficking channels employed in plant communication.

We acknowledge the irony in asking biologists to think about communication and signalling networks at a time when our interpersonal communication and daily lives have been disrupted by shutdowns and social isolation to combat the SARS-CoV-2 pandemic. We are grateful to the contributing writers for finding time to write these reviews in the midst of video conferencing meetings, online teaching, and all of the other new duties that arose in 2020. We hope that the thoughts on recent successes and ideas for new pathways to pursue given in these reports will motivate and energise research when we return to our laboratories. Cell biologists have learned that the biophysics of phase separation regulates a variety of functions since the discovery that so-called "P granules" (bodies constituted of particular RNAs and RNA binding proteins) are phase-separated liquid droplets about 10 years ago. The impact of these "membraneless organelles" on plant cell biology is highlighted in two reviews in this issue.

Wunder and Mueller-Cajar discuss liquid–liquid phase separation in the context of primary metabolism, emphasising how different lineages have evolved mechanisms, such as phase separation, to concentrate CO2 gas with the photosynthesis carbon-fixing enzyme RuBisCO, to maximise productive carboxylation and minimise wasteful ribulose-1,5-bisphosphate oxygenation. The authors then expand their thinking to explore the importance of liquid–liquid phase separation in other metabolic processes like nucleotide synthesis and glycolysis, as well as the possibility of engineering phase separated metabolic pathways to improve synthetic biology efforts.

Meyers, on the other hand, emphasises the importance of liquid–liquid phase separation in signal transduction pathways. Various liquid-like ‘nuclear entities,' such as phytochrome-containing ‘photobodies,' that develop in reaction to specific light quality, have been discovered in recent years. Meyers describes how phase separation of transcription factors, transcripts, and RNA binding proteins may regulate responses to environmental conditions, as well as other nuclear bodies that reversibly develop in response to environmental cues such as light, osmotic stress, and temperature.

Hanson and Conklin provide a detailed overview of recent breakthroughs in our understanding of stromules, the long, stroma-filled tubular extensions of chloroplasts and other plastids seen in practically every plant species and cell type. Since the Hanson lab's rediscovery of stromules 25 years ago, they and other labs have shown that various stimuli influence stromule generation and morphology, but the biological activities of stromules have only lately come into focus.

Finally, Bhandari and Brandizzi summarise the most recent research on the role of the plant cytoskeleton and endomembrane systems in pathogen-plant interactions. To resist invading bacteria, the secretory system delivers a variety of payloads to microbial contact sites, but disease-causing microbes have evolved to use the cytoskeleton and endomembrane to increase pathogenesis. Bhandari and Brandizzi describe our current understanding of these intricate connections and conclude that concentrating future research on the interactions between the cytoskeleton, endomembrane system, and pathogens could lead to novel ways for engineering broad-spectrum pathogen resistance.

The potential of cellular components to fulfill various, context-dependent tasks in cell signaling are revealed by studying the mechanisms of cell signalling. What emerges from these studies is the ability of the plant to dynamically maintain cellular homeostasis and coordinate growth, from communication between organelles to the diverse roles of the endomembrane, cytoskeleton, and membrane less compartments in biotic and abiotic responses, to the integration of local cues with signals from distant tissues.

***Correspondence to:**

Rosy Franco
Managing Editor
Journal of Cell Biology and Metabolism
United Kingdom
E-mail:structuralbiology@europeconferences.com