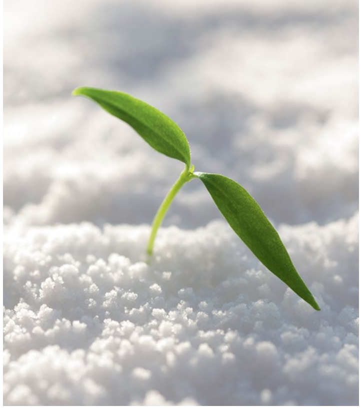
Credit: avdeev007/Getty

Indeed, mutations designed to affect the structure of the region encompassing the hyper-variable interfered with *FLC* expression and flowering time. The authors propose that *COOLAIR* acts by physical association with chromatin around transcription start site of *FLC*, but the details of *FLC* regulation require further investigation.

> *FLC* expression is fine-tuned by RNA structure conformational changes in *COOLAIR* transcripts

In summary, this work provides a novel single-molecule RNA structure profiling method and a new, structural perspective on how plants translate environmental signals into physiological responses.

Lisa Heinke

ORIGINAL ARTICLE Yang, M. et al. In vivo single-molecule analysis reveals *COOLAIR* RNA structural diversity. *Nature* https://doi.org/10.1038/s41586-022-05135-9 (2022)

of CBL8 reduced seedling survival in high-salt conditions. Like CBL4, CBL8 was demonstrated to partner with CIPK24 and to be targeted to the plasma membrane of roots.

> CBL8 is a specific mediator of high salt stress in plant roots

Unlike CBL4, CBL8 was found to respond to Ca^{2+} elevation by undergoing conformational change, and its interaction with CIPK24 was strictly Ca^{2+}-dependent. Thus, the authors propose that CBL4 mediates homeostatic and low stress-induced Na^+ extrusion, whereas CBL8 is a specific mediator of high salt stress in plant roots able to translate the Ca^{2+} signal into increased Na^+ extrusion. Accordingly, overexpression of *A. thaliana* CBL8 in tobacco plants increased their capacity for Na^+ extrusion and improved their salt tolerance.

Finally, phylogenetic analysis revealed that CBL8 emerged specifically in dicot plants. Thus, introducing CBL8 into monocot plants — which include many important crops — could be a strategy to increase their salt tolerance.

Paulina Strzyz

ORIGINAL ARTICLE Steinhorst, L. et al. A Ca^{2+}-sensor switch for tolerance to elevated salt stress in *Arabidopsis*. *Dev. Cell* https://doi.org/10.1016/j.devcel.2022.08.001 (2022)

Journal Club

PLANT STRESS RESPONSES

ETHYLENE — THE LIFEGUARD HORMONE

Some plant species, such as deepwater rice, can accelerate shoot elongation when submerged in water, which allows the plant to outgrow the floodwaters. A principal regulator of this flood escape strategy is the gaseous plant hormone ethylene. Ethylene accumulates quickly in flooded tissues because of its impeded diffusion and low solubility in water.

However, while submergence-induced elongation in plants had been widely observed, starting from the early 1900s, the identity of the causal signal remained unclear for a long time. Up until the 1960s, ethylene was still infamous as an air pollutant that negatively affected plant growth and development. So entrenched was this association, that ethylene promoting plant growth was considered almost inconceivable.

In 1972, a paper published in *Nature* characterized stem elongation in the amphibious plant *Callitriche platycarpa*. When submerged, *Callitriche* rosette internodes show a remarkable increase in elongation rates. Previous reports had attributed this to the growth hormone gibberellic acid (GA), although GA could never completely replicate the submergence triggered growth response. By contrast, Musgrave et al. convincingly demonstrated that ethylene application could mimic underwater elongation and proved that while the ethylene response was GA-dependent, it was the accumulation of ethylene that was the primary elongation signal. Notably, these concentrations of ethylene were detected in photosynthetically generated gas bubbles from submerged *Callitriche* rosettes. This study was thus able to credibly establish that the floodwater caused the entrapment of ethylene to physiologically active concentrations. Several studies have subsequently validated these findings, opening the door to further explorations of ethylene as a key regulator of various flooding survival traits.

The fast, passive and pervasive nature of ethylene accumulation make it a very reliable and timely flood warning cue for plants. In the present day, submergence-induced ethylene accumulation is firmly established as a vital signal triggering not just shoot elongation but various other metabolic and morphological adaptations to flooding. This includes metabolic acclimations to submergence-induced hypoxia and adaptive traits that enhance plant aeration underwater to avoid hypoxia. Examples of the latter include the formation of air spaces (aerenchyma) in plant tissues and aerenchyma-rich shoot borne roots that are formed close to the water surface. Early ethylene entrapment is also beneficial in ameliorating oxidative stress associated with reoxygenation following floodwater retreat. The downstream signalling networks and transcription factors mediating these panopoly of ethylene effects have been identified for many of these survival traits.

> This study was thus able to credibly establish that the floodwater caused the entrapment of ethylene to physiologically active concentrations

Such mechanistic characterization will be important in the quest to transfer tolerance traits to flood sensitive plants. This is particularly pertinent considering global warming-related increase in flooding events and the high vulnerability of current crop varieties to this abiotic stress.

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ORIGINAL ARTICLE Musgrave, A. et al. *Callitriche* stem elongation is controlled by ethylene and gibberellin. *Nat. New Biol.* **238**, 93–96 (1972)