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Review: Salt stress sensing and early signalling events in plant roots: current knowledge and hypothesis

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Highlights

► Plant membranes harbour many types of transport proteins that can act as a sodium sensor(s)
► To operate as a sensor, several transport proteins are clustered together to form a "microdomain" in a lipid raft
► Sensing mechanisms operate *in parallel* providing plants with a robust system of decoding information about the specific nature and severity of the salt stress

Abstract

Soil salinity is a major environmental constraint to crop production. While the molecular identity and functional expression of Na^+ transport systems mediating Na^+ exclusion from the cytosol has been studied in detail, far less is known about the mechanisms by which plants sense high Na^+ levels in the soil and the rapid signalling events that optimise plant performance under saline conditions. This review aims to fill this gap. We first discuss the nature of putative salt stress sensors, candidates which include Na^+ transport systems, mechanosensory proteins, proteins with regulatory Na^+ binding sites, sensing mediated by cyclic nucleotide-gated channels, purine receptors, annexin and voltage gating. We suggest that several transport proteins may be clustered together to form a microdomain in a lipid raft, allowing rapid changes in the activity of an individual protein to be translated into stress-induced Ca^{2+} and H_2O_2 signatures. The pathways of stress signalling to downstream targets are discussed, and the kinetics and specificity of salt stress signalling between glycophytes and halophytes is compared. We argue that these sensing