Plant adaptive potential is critically dependent upon efficient communication and co-ordination of resource allocation and signalling between above- and below-ground plant parts by various physical, chemical and molecular signals. This review summarises the current knowledge of these signalling mechanisms, and reveals the hierarchy and discuss integration of these signalling components, to enable optimal plant functioning in a dynamic environment.

Although ACC-deaminase containing rhizobacteria have previously been shown to improve plant growth under salt stress, this study is the first to investigate ion homeostasis using nutrient flow modelling, and to demonstrate both stomatal and non-stomatal effects of such rhizobacteria on photosynthesis. *Variovorax paradoxus* 5C-2 may be an eco-friendly and economic means of decreasing deleterious effects of salinity on plant production by improving ion homeostasis and photosynthesis.

Soil compaction is a major environmental threat to arable land that adversely affects root growth and crop productivity. The reproducibility of field results under controlled conditions will be crucial to identify root traits that are suitable for such conditions at high throughput rates. This study showed that root responses to soil compaction in the field were, to a large extent, reproducible under controlled conditions, and that roots were affected by increased mechanical impedance and limited oxygen availability.

The root system of a plant is essential for nutrient acquisition, but our understanding of how root form and function have diverged across soil fertility gradients is limited. Here, we report on several significant differences found in root form and function between species native to environments varying in soil fertility. However, the direction and magnitude of these differences did not always agree with traditional assumptions, indicating that further research is needed to better understand the role of root system traits in adaptation to soil fertility.
A SDD1-like subtilase is exuded by tobacco roots
Tim Wendlandt, Martin Moche, Dörte Becher and Christine Stöhr

Subtilases are proteolytic enzymes with key roles in plant development and signal transduction. SDD1 is a subtilase, which is associated with stomata development in Arabidopsis thaliana. We identified a SDD1-like subtilase in tobacco root exudate that shows high activity with gelatine as substrate. The physiological role of the subtilase remains cryptic but two co-purified proteins provide an informative basis for the identification of in vivo substrates of the subtilase.

Tracer experiment using $^{42}$K$^+$ and $^{137}$Cs$^+$ revealed the different transport rates of potassium and caesium within rice roots
Natsuko I. Kobayashi, Ryohei Sugita, Tatsuya Nobori, Keitaro Tanoi and Tomoko M. Nakanishi

Radiocaecium, one of the key pollutants in environment, has been considered to mimic potassium movement within a living organism. Here, the kinetics of radiocaesium at root uptake, passage through root cells, and xylem flow were characterised in comparison with those of potassium. The knowledge about characteristic behaviours of radiocaesium contributes the crop breeding aiming to reduce the radiocaesium contamination.

Rhizosphere bacteria containing 1-aminocyclopropane-1-carboxylate deaminase increase growth and photosynthesis of pea plants under salt stress by limiting Na$^+$ accumulation
Qiyuan Wang, Ian C. Dodd, Andrey A. Belimov and Fan Jiang

Although ACC-deaminase containing rhizobacteria have previously been shown to improve plant growth under salt stress, this study is the first to investigate ion homeostasis using nutrient flow modelling, and to demonstrate both stomatal and non-stomatal effects of such rhizobacteria on photosynthesis. Variovorax paradoxus 5C-2 may be an eco-friendly and economic means of decreasing deleterious effects of salinity on plant production by improving ion homeostasis and photosynthesis.

Wheats developed for high yield on stored soil moisture have deep vigorous root systems

Field selection for wheats with deep, vigorous root systems was performed in India and Australia using soil coring. Variation for deep root traits was observed in 49 Indian wheats grown alongside 41 Australian wheats. Despite the high variability between sites and years several Indian genotypes were identified that ranked consistently for deeper root traits.

Brachypodium distachyon genotypes vary in resistance to Rhizoctonia solani AG8
Katharina Schneebeli, Ulrike Mathesius, Alexander B. Zwart, Jennifer N. Bragg, John P. Vogel and Michelle Watt

Rhizoctonia root rot is a costly disease in wheat and other cereals, and there are no crop varieties available with improved resistance. We found variation in resistance to Rhizoctonia in diverse lines of Brachypodium, a grass that is widely used as a model for the cereals. These lines respond differently during infection and may, with further work, reveal genetic regions in cereals that can be targeted to develop varieties with increased resistance to Rhizoctonia.

Enhanced root growth of the brb (bald root barley) mutant in drying soil allows similar shoot physiological responses to soil water deficit as wild-type plants
Ian C. Dodd and Eugene Diatloff

Root hairs drastically increase the surface area of the root system and are believed to be important in nutrient and water uptake. Although a root hairless mutant (brb) and its wild type (WT) maintained similar transpiration rates and leaf elongation in well-watered conditions, in drying soil leaf elongation of brb was diminished during the photoperiod (but not over 24 h), despite having more root biomass than the WT. Thus, root hairs have a limited role in regulating physiological responses to soil drying.
Salt-stress induced alterations in the root lipidome of two barley genotypes with contrasting responses to salinity

Siria H. A. Natera, Camilla B. Hill, Thusitha W. T. Rupasinghe and Ute Roessner

Salinity is an increasing challenge to crop growth in many areas of the world. The root lipids in two barley lines that have different salt tolerance levels were investigated to determine how they change as a result of exposure to saline conditions. Differences in root lipids may provide insight into how plants react to and potentially tolerate high soil salt concentrations.

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