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UPTAKE AND TRANSPORT OF NITRATE IONS IN PLANTS AND THEIR EFFECT ON ROOT ARCHITECTURE

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Summary

In response to varied availability of nitrogen in the soil plants developed mechanisms to improve the efficiency of uptake of this element, in particular several NO_3^- transport systems. These transport systems belong to the following protein families: NPF (formerly NRT1), NRT2, CLC and SLAC1. NPF (symporters) are active when the NO_3^- concentration in the environment is higher than 0,5 mmol·dm^{-3} and due to its low specifity for nitrate ions it also may transport other substrates such as e.g. amino acids. NRT2 protein family (symporters) transports nitrates and operates only when the external NO_3^- concentrations are below 0,5 mmol·dm^{-3}. SLAC1 proteins (anion channels) are located in the guard cells and are involved in the efflux of chloride and nitrate ions during the closing of stomata. CLC family apart from transporting Cl^- has a high affinity for NO_3^-. One of the members of these proteins, CLCa, is located in the tonoplast and is involved in the transport of nitrate ions to the vacuole in antiport with protons.

After uptake by root cells, nitrate ions are distributed to various tissues and organs of the plant due to activity of other transporters belonging to the above-mentioned protein families.

One of the most visible changes in response to the diverse resources of nitrates is a change in the architecture of roots. High concentrations of NO_3^- (50 mmol·dm^{-3}) in a substrate cause inhibition of branching of the root system. In the case of limited availability of nitrates (0,01 mmol·dm^{-3}) stimulation of lateral root development occurs towards soil areas with higher NO_3^- content (1,0 mmol·dm^{-3}). In *A. thaliana* modifications of roots architecture occur without significant alteration in the biomass of roots, because the development of laterals is balanced by shortening of the main root. The low content of nitrate ions is a signal to expand the root system, while a high content of this ions is the signal to develop shoots.