

Abstract

Lateral roots are, due to their large absorption surface, a part of the root system with significant importance for the plant's ingestion of water and nutrients. Their development depends on heterogeneity of soil environment, which enables the plant to optimize the acquisition of resources under current conditions. The availability of mineral nutrients (type of nutrient, form, distribution in soil and mobility) is one of key factors that determine root system morphogenesis. Another important aspect is the amount of nutrient in the plant; in other words, the plant's current demand for the element. The most important nutrients that influence the architecture of the root system are two macroelements – nitrogen and phosphorus. Both of these elements trigger positive and negative effects on the development of lateral roots.

Nitrate, important source of nitrogen, induces two entirely different regulatory mechanisms of lateral root development. Under nitrogen limiting condition, a local stimulation of lateral root elongation is triggered in nitrate-rich patches. This response integrates the signalling pathways of auxin and nitrate.

In contrast, high and homogenous availability of nitrate in rhizosphere (≥ 10 mM) causes inhibition of lateral root growth. This systemic inhibitory effect was similarly observed with ammonium ions as a nitrogen source. Another N-rich compound with significant potential to affect lateral root growth is glutamate.

In the case of phosphorus, an effect on the growth of lateral roots was also observed. Phosphorus deficiency increases root sensitivity towards auxin, which suppresses growth of the main root axis and stimulates the growth of lateral roots.