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Changes in plant hydraulic conductivity in response to water deficit

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Abstract

How do plants take up water from soils especially when water is scarce in soils? Plants have a strategy to respond to water deficit to manage water necessary for their survival and growth. Plants regulate water transport inside them. Water flows inside the plant *via* (i) apoplastic pathway including xylem vessel and cell wall and (ii) cell-to-cell pathway including water channels sitting in cell membrane (aquaporins). Water transport across the root and leaf is explained by a composite transport model including those pathways. Modification of the components in those pathways to change their hydraulic conductivity can regulate water uptake and management. Apoplastic barrier is modified by producing Casparian band and suberin lamellae. These structures contain suberin known to be hydrophobic. Barley roots with more suberin content from the apoplast showed lower root hydraulic conductivity. Root hydraulic conductivity was measured by a root pressure probe. Plant root builds apoplastic barrier to prevent water loss into dry soil. Water transport in plant is also regulated in the cell-to-cell pathway *via* aquaporin, which has received a great attention after its discovery in early 1990s. Aquaporins in plants are known to open or close to regulate water transport in response to biotic and/or abiotic stresses including water deficit. Aquaporins in a corn leaf were opened by illumination in the beginning, however, closed in response to the following leaf water potential decrease. The evidence was provided by cell hydraulic conductivity measurement using a cell pressure probe. Changing the hydraulic conductivity of plant organ such as root and leaf has an impact not only on the speed of water transport across the plant but also on the water potential inside the plant, which means plant water uptake pattern from soil could be differentiated. This was demonstrated by a computer simulation with 3-D root structure having root hydraulic conductivity information and soil. The model study indicated that the root hydraulic conductivity plays an important role to determine the water uptake from soil with suboptimal water, although soil hydraulic conductivity also interplayed.

Keywords: Apoplastic barrier, Aquaporins, Barley, Corn, Hydraulic conductivity

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