

Title Non-destructive measurement of water flow in small plants using cold neutron radiography - an application to investigate bent-neck symptom of cut roses

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Abstract

Damaging millions of cut roses the bent-neck syndrome is a widespread problem related to structural weakness of the vascular bundles, reduced cell wall strength or water supply limitations. Structural characteristics of three cut rose (*Rosa hybrida* L.) cultivars were investigated to analyze the possible causes of this postharvest problem. The cultivars 'Akito', 'Milva' and 'Red Giant' have low, middle and high bent-neck resistances, respectively. In experiments performed at HZB's neutron tomography instrument CONRAD the non-destructive visualization methods cold neutron radiography (CNR) and cold neutron tomography (CNCT) were applied to in situ observe water transport through and structure of the peduncles of roses. A D₂O tracer technique was used to visualize water flow. The vectors of water uptake and water transport in the roses were calculated using an optical flow algorithm. After drought stress 'Akito' and 'Milva' roses rapidly lost water due to the immature epidermal structure. However, water uptake of 'Milva' was fast and the efficient water conducting system provides 'Milva' roses certain bent-neck resistance. Roses of 'Red Giant' should be strong against dehydration because of their well developed vascular bundle structure and their thick cuticle. Water uptake during rehydration was slow, because this cultivar could retain water inside. Also, the mechanical structure of its vascular bundles was strong enough to prevent bending. Concluding, neutron radiography provides reliable information on the structure and the water transport processes in plants.