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Agriculture: Water quantification measurement of therapeutic roots in soil for analyzing hydrology using neutron imaging under smart agriculture - Review and Perspective of neutron imaging for Agriculture

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A movement of water through plants has been the focus of scientific investigation for over 250 years. Recent developments(2008-2022) of neutron imaging in the field of in vivo plant have advanced to the point of near real-time visualization of water transport both through the rhizosphere and the xylem system of plants. In this workshop, the related research will be reviewed and looked at terms of future neutron imaging tools for expanding agriculture and food production.
Neutron imaging permitted an irrigation monitoring of plant health and the detection of root pathological changes over a period of measuring root water content in situ. Monte Carlo simulation of water quantification measurement of root in soil using the thermal neutron imaging system shows that penetration rate of thermal neutron is 27% through a water content of 0.071 mL (3mm diameter and 10 mm height) ~ 7.065 mL (30mm diameter and 10 mm height) of Al-water phantom. It was embedded in various 0~12% humidity of soil contained with 60 mm diameter and 300 mm height of Al-pot. In practical experiments, a fitted calibration curve was constructed to quantitatively measure an amount of water of roots growing directly in Al pot. The quantification with error 5% of scattering effect of water content of 3-year-old roots in Al-pot soil of electron beam sterilization treatment with moisture of 7.7% of cultivation field was 70.0%, 55.0%, and 70.0%, respectively based on the developed calibration curve. The quantification measurement of water amount can be used for analyzing botanical hydrology of roots growing in soils in association with its seedling, breeding and culturing by neutron imaging under smart vertical farming in agriculture.

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Dr Sim received his PhD in Electronic Engineering in 1998 and has since also extensively studied the field of agricultural sciences by employing electron beam and neutron imaging techniques. He was involved with the establishment and characterization of High-Flux Advanced Neutron Application Reactor (HANARO) neutron radiography facility at KAERI. He has experience in a number of diverse fields and is involved with numerous collaborations which include development of lithium batteries, hydrogen fuels, neutron detectors, ultrasonic systems, fast neutron interrogation systems and aircraft neutron radiography inspection systems.

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