Contribution ID: 10 Type: Oral

Distribution of aluminium in plant roots: Understanding its toxicity through correlative microscopy

Friday, 21 November 2014 13:45 (30 minutes)

Aluminium (Al) is toxic to plant root growth in the acid soils comprising ca. 40-70% of the world' s arable land, but the mechanisms whereby Al reduces growth remain unclear. Despite 30 µM Al decreasing root growth within 30 min, we are unaware of any study that has provided information on the distribution of Al in roots within this timeframe. Using roots of soybean (Glycine max (L.) Merr.) exposed to 30 µM Al, we identified and separated individual mechanisms of toxicity through the use of high resolution kinematic analyses together with the complementary use of synchrotron-based low-energy X-ray fluorescence spectromicroscopy (LEXRFS) and nano secondary ion mass spectroscopy (nanoSIMS). The latter techniques revealed the majority of Al to be located in the outer cellular layers within 30 min of exposure, decreasing markedly with increasing distance from the root surface. At the sub-cellular level, the majority of the Al was found to accumulate in the cell wall. Of particular importance, Al was bound strongly by (i) pectin in the corner junctions between cells, with this typically the location where Al first accumulated in the inner tissues, (ii) walls of the border cells (c.f. the walls of the adjacent rhizodermal cells), and (iii) the mucigel on the root surface. For the first time, correlative microscopy (LEXAFS and nanoSIMS) and other complementary techniques have provided important evidence as to where Al accumulates in the short term and how Al rapidly reduces the growth of plant roots.

Keywords or phrases (comma separated)

Correlative microscopy, Metal toxicity, Plant roots

Primary author: Dr KOPITTKE, Peter (The University of Queensland)

Co-authors: Dr GIANONCELLI, Alessandra (Synchrotron Radiation Facility, Elettra Sincrotrone, Trieste-Basovizza, Italy); Prof. LOMBI, Enzo (University of South Australia, Centre for Environmental Risk Assessment and Remediation, Mawson Lakes, South Australia, 5095, Australia); Dr MOORE, Katie (University of Oxford, Department of Materials, Oxford, OX1 3PH, United Kingdom); Prof. MENZIES, Neal (The University of Queensland, School of Agriculture and Food Sciences, St. Lucia, Queensland, 4072, Australia); Prof. BLAMEY, Pax (The University of Queensland, School of Agriculture and Food Sciences, St. Lucia, Queensland, 4072, Australia)

Presenter: Dr KOPITTKE, Peter (The University of Queensland)

Session Classification: Earth and Environment

Track Classification: Earth and Environment