PROJECT: pH/HM on root growth

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PROJECT TITLE

Interaction of heavy metals and pH on plant growth and root cell viability

CONSORTIUM

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SUMMARY OF THE REPORT

The cell and developmental mechanisms by which plants adapt to toxic elements (TE) in the environment are not yet fully understood. Root growth is negatively impacted by contaminated soils and, and this affects growth of the whole plant. Breeding for tolerance or reduced uptake of toxic elements is challenging because uptake often occurs alongside nutritive elements and TEs directly affect root ultrastructure (Barcelo et al. 2004) and cell viability (our own results). If translocated to the shoot, TE may cause damage to photosynthesis (Küpper et al. 2007) and cause dwarfism (Viehweger and Geipel 2010), leading to overall biomass reduction.

The rate of toxic element uptake by the roots depends, in part, on the chemical form in which they appear in the soil and it has been widely documented that HM uptake is strongly pH dependent (Hollier and Reid 2005; Wang et al. 2006). Notably, lower pH tends to promote uptake of heavy metals by plants (Lenart and Wolny-Koładka, 2013, Adamczyk-Szabela, 2015) and has become an actual problem in recent years due to soil acidification resulting from widespread fertilization.

The processes underlying root growth are “zonally” restricted. Thus, the quiescent centre is a reservoir of undifferentiated cells that are precursors of all the other root tissues. Most cell proliferation occurs in the apical meristem, while cell expansion occurs primarily in the elongation zone and cell maturation takes place in the differentiation zone. Our preliminary data indicate that HMs cause different cellular and physiological affects on cells in various growth zones. For example, many HMs cause cell death preferentially in the maturation zone, while others such as Al ions impact the apical meristem (Li et al., 2015). Our project aims to test how soil water pH affects the phenotype of roots in the presence of different heavy metals (i.e. Cd2+, Al3+). Hydroponics and vertical plate approaches have been used to assess growth under constant levels of metal ions at different pH and the changes in growth and gene expression that occur when roots become exposed to HM. We utilized genetically characterised strains from 2 species, the model plant Arabidopsis, and the forage crop, *Lolium perienne*, which has remediation potential in polluted areas (Penrose et al 2017), to phenotype growth responses to selected HM at different pH regimes.