

# Effects of pH stress on root exudation of yorkshire fog and red clover and its implications on the revegetation of mining and industrial waste

FELIPE ESTEBAN SEPULVEDA OLEA<sup>1</sup>, DOUG I STEWART<sup>1</sup>, IAN T BURKE<sup>1</sup> AND ROBERT D HANCOCK<sup>2</sup>

<sup>1</sup>University of Leeds

<sup>2</sup>The James Hutton Institute

Presenting Author: f.sepulvedaolea@leeds.ac.uk

Development of vegetative cover on the surface of waste deposits provides not only a physical protective layer, but may also have other effects on the material (e.g. enhanced metal mobility) as plants release organic compounds through their roots. Concentration values are highly variable, depending on the plant species and environmental conditions, with stress conditions greatly influencing exudation.

Alkaline wastes such as red mud (bauxite), have historically been widely produced and pose a challenge in terms of management and ecological restoration. Yorkshire fog grass (*Holcus lanatus*) and red clover (*Trifolium pratense*) are plant species that have been used in red mud restoration, along with organic and mineral treatments, resulting in positive long term effects.

In this work the effects of pH-stress conditions (pH ~10) on root exudation of both these grassland species is studied in a hydroponic growth set up. Root exudates were collected in solution in four 3-hour periods distributed throughout the photoperiod. The final pH was ~6.5-7 and ~4.8-5.7 in non-stressed yorkshire fog and red clover exudate solutions respectively, and 7.2-7.6 under stressed conditions in both cases. For yorkshire fog, the net exudation had no statistical variation at different times of the photoperiod, with an average of 263  $\mu\text{g DOC (g-root)}^{-1}(\text{hrs})^{-1}$  in non-stressed conditions and 220  $\mu\text{g DOC (g-root)}^{-1}(\text{hrs})^{-1}$  in pH-stressed conditions, and no statistically significant difference between the two. Non-stressed red clover did show diurnal variation with an average of 280 and 92  $\mu\text{g DOC (g-root dry mass)}^{-1}(\text{hrs})^{-1}$  in the first and two last collection periods respectively. There was no statistical difference with net exudation under stressed conditions, which had an average of 118  $\mu\text{g DOC (g-root dry mass)}^{-1}(\text{hrs})^{-1}$ . This would indicate that the overall exudation rate was not greatly affected by pH as an environmental stressor.

GC-MS analysis of the exudate solutions, however, shows a shift from a sugars and alcohols-dominated exudate solution in non-stressed conditions to an organic acids-dominated solution in pH stressed plants, both in yorkshire fog and red clover, denoting a clear stress response that could have implications in the interaction with metals present in the growth substrate (i.e. waste), to be further discussed.

