Conference or Workshop Item

Penrose, B.; Beresford, N.; Broadley, M.; Crout, N.M.J.; King, J.; Lovatt, A.; Thomson, R.; Young, S. 2014. **Can inter-cultivar variation in caesium and strontium uptake reduce contamination of forage grasses?** In: *3rd International Conference on Radioecology and Environmental Radioactivity, Barcelona, 7-12 Sept 2014*.

Can inter-cultivar variation in caesium and strontium uptake reduce contamination of forage grasses?

B. Penrose [1,2], N. Beresford [1], M. Broadley [2], N.M.J. Crout [2], J. King [2], A. Lovatt [3], R. Thomson [4], S. Young[2]

[1]NERC Centre for Ecology & Hydrology, Lancaster Environment Centre, Library Avenue, Lancaster, LA1 4AP, UK, [2]School of Biosciences, University of Nottingham, Sutton Bonington Campus, Leicestershire, LE12 5RD, UK, [3]Institute of Biological, Environmental and Rural Sciences (IBERS), Aberystwyth University, Gogerddan , Aberystwyth, Ceredigion, SY23 3E E, UK, [4]Science and Advice for Scottish Agriculture (SASA), Roddinglaw Road, Edinburgh, EH12 9FJ, UK

INTRODUCTION

Radiocaesium and radiostrontium enter the food chain primarily via plant root uptake, including indirectly via animal fodders. Inter-species variation in caesium and strontium accumulation in plants has previously been reported to be over two orders of magnitude. This variation could be exploited to select crops with relatively low uptake to reduce transfer of these radionuclides to consumers in contaminated areas. Exploiting intra-species (i.e. inter-cultivar) variation in caesium and strontium uptake has not yet been evaluated as a remediation strategy as sufficient data have not been available.

As cows' milk has been one of the main contributors to human dose following the Chernobyl and Mayak accidents, we have chosen to focus on elucidating the extent and nature of inter-cultivar variation in caesium and strontium uptake in forage grasses.

MATERIALS AND METHODS

In total, 415 cultivars from four species of forage grass; perennial ryegrass (*Lolium perenne*; 287 cultivars), Italian ryegrass (*Lolium multiflorum*; 17 cultivars), hybrid ryegrass (101 cultivars) and tall fescue (*Festuca arundinacea*; 10 cultivars) were sampled from 20 sets of experimental plots in Aberystwyth (Wales) and Edinburgh (Scotland). Fifty-nine cultivars were grown in both locations. At least three replicates of the same cultivar were grown in each set of plots. Plots range from $1m^2$ - 3.1 m^2 and a set of experimental plots contains between 40 and 416 plots, where all plots in each set are sown, fertilised and harvested at the same time.

Vegetation samples (~200-300 g dry weight) from 2208 plots were collected in spring 2013 (May-June). The samples were oven-dried at 80°C and milled, homogenised and a sub-sample (~10 g) was taken. The sub-sample was then acid digested and analysed for elemental composition using inductively coupled plasma mass spectrometry (ICP-MS). Concentrations of stable caesium and strontium were measured as a proxy measurement for radiocaesium and radiostrontium concentrations. Samples of the soil 0-15 cm deep (~240 g-1330 g dry weight)

from each set of experimental plots were also collected, air-dried at 35°C, milled, homogenised and a small subsample (~15 g) was taken. This subsample was acid digested and analysed for elemental composition using ICP-MS.

RESULTS

Initial results suggest that within the 415 cultivars being studied, some can be identified as displaying caesium and strontium concentrations considerably lower than others. Further analysis is currently underway.

ONGOING WORK

Vegetation samples from all 2208 plots were also collected in summer 2013 (August-September), and will be analysed using the same method as above. In addition to this, vegetation samples will collected in spring and summer 2014, and analysed as above. It is hoped that both intra- and inter-annual variation in Cs and Sr concentrations can be better elucidated.

A field experiment consisting of three replicates of six cultivars of perennial ryegrass (two identified as having low caesium and strontium concentrations, two identified as having medium concentrations and two identified as having high concentrations) and two cultivars of tall fescue was sown in May 2014 near Narodychi, Ukraine, close to the Chernobyl exclusion zone. The grass is due to be harvested in September 2014 and the caesium-137 and strontium-90 activity concentrations will be measured. Activity concentrations of the same radionuclides in the soil in each plot will also be measured. Concentrations of stable caesium and strontium in the soil and grass will be measured using ICP-MS. It is hoped that consistency between concentrations of radiocaesium and stable caesium, and radiostrontium and stable strontium can be further understood

ACKNOWLEDGEMENTS

The authors would like to thank Vasyl Pronevych and his team for their help with experimental work in the Ukraine. They would also like to thank Scott Young (Nottingham University) for his help with the elemental analyses using ICP-MS. This work was supported by the UK Natural Environment Research Council (B. Penrose PhD funding).