Occurrence and Changes of Classic and Emerging Contaminants in Soils Treated by Organic Wastes

Zulin Zhang[1]*, Hui Lin[2], Mark Osprey[1], Stephen J. Chapman[1], Thomas E. Freitag [1], Stewart M. Rhind[1], Carol E. Kyle[1], Dave Hamilton[1]

[1]The James Hutton Institute, Craigiebuckler, Aberdeen AB15 8QH, UK;
[2]The Institute of Environmental Resource and Soil Fertilizers, Zhejiang Academy of Agricultural Sciences, Hangzhou 310021, P.R. China
(*Email: zulin.zhang@hutton.ac.uk)

The James Hutton Institute

Introduction

- As the costs of fossil fuel and inorganic fertiliser increases and availability declines, there is an increasing requirement to recycle nutrient-rich organic wastes to land, as fertilisers.
- However, as noted in the State of Scotland's Soil Report (Dobbie et al., 2011), organic materials can also contain potentially toxic constituents such as organic chemicals, metals and pathogens, and so application of organic materials to land has the potential to increase levels of contaminants in soils and cause harm to the environment, and would have effects on soil biota that may be critical for long term sustainable food productivity and food security.
- Therefore, the objective of this work is to trace the changes of contaminants in the agricultural soils amended by different organic wastes (sewage sludge, compost and manure). The target contaminants would include both classic chemicals and emerging contaminants (e.g. antibiotic resistance genes (ARGs)).

Experimental

- The field experiment was conducted at the James Hutton Institute research station at Glensaugh, Aberdeenshire, UK.
- Twelve experimental plots (15 m × 15 m; 4 treatments × 3 replicates per treatment) were marked within a single field.
- Organic fertilizer were applied to the surface of 9 plots at a rate equivalent to 2.25 tonnes/ha for sewage sludge, 10 tonnes/ha for farm manure and 13 tonnes/ha for compost. Inorganic fertilizer containing an equivalent amount of N (225 kg/ha) was applied to the 3 remaining plots as a control.
- Soil samples were collected for chemical analysis (including diethylhexyl phthalate (DEHP), PAHs, PCBs, PBDEs, PPCPs etc. some data not shown here) and ARGs analysis.

Figure 1 Organic Wastes Land Application in Glensaugh, Scotland

Result and Discussion

- Figure 2 summarises the predicted environmental concentration (PEC, calculated by the chemical content in organic wastes and the organic wastes application rate to soils) of DEHP in different organic wastes treated soils. The PEC-DEHP concentrations in treated soils showed as following order: Sludge>Compost>Manure. These trends are in agreement with the measured DEHP concentration in the differently amended soils (Figure 3), which suggested that the organic wastes introduced the chemical and increased/accumulated the contaminants in the treated soils.
- In all treatments, the relative abundance of most ARGs detected decreased over time, especially *IntI*1 and *tet* ARGs. However, it is interesting to find that the multiple applications of organic fertilizers resulted in higher ARGs in comparison to inorganic fertiliser (NPK), either by a lesser decrease of *IntI*1 and *tet* ARG or an increase of *sul* ARG (Figure 4).

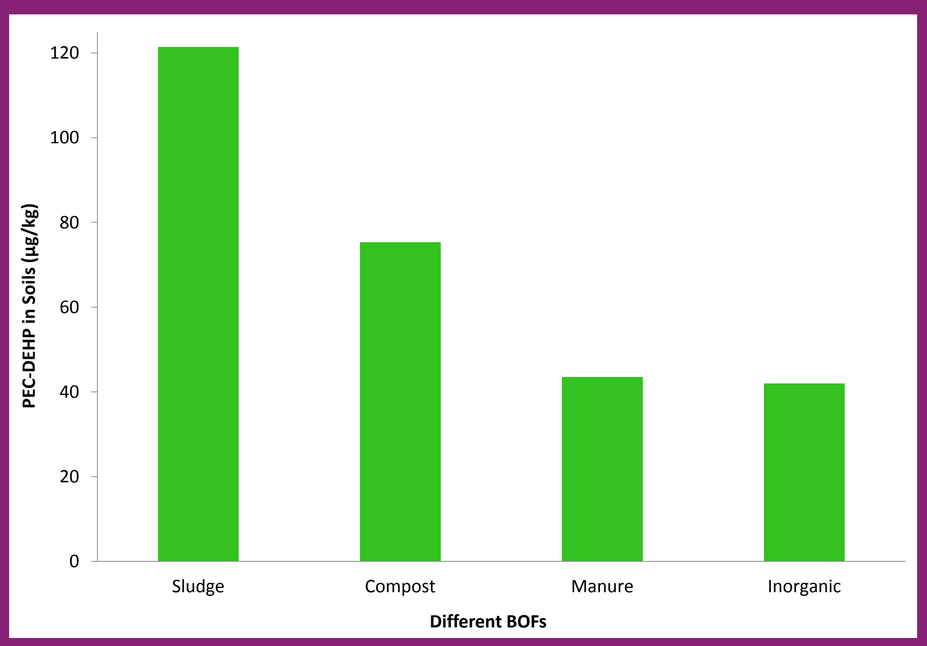

Figure 2 PEC-DEHP in Different Organic Wastes Treated Soils

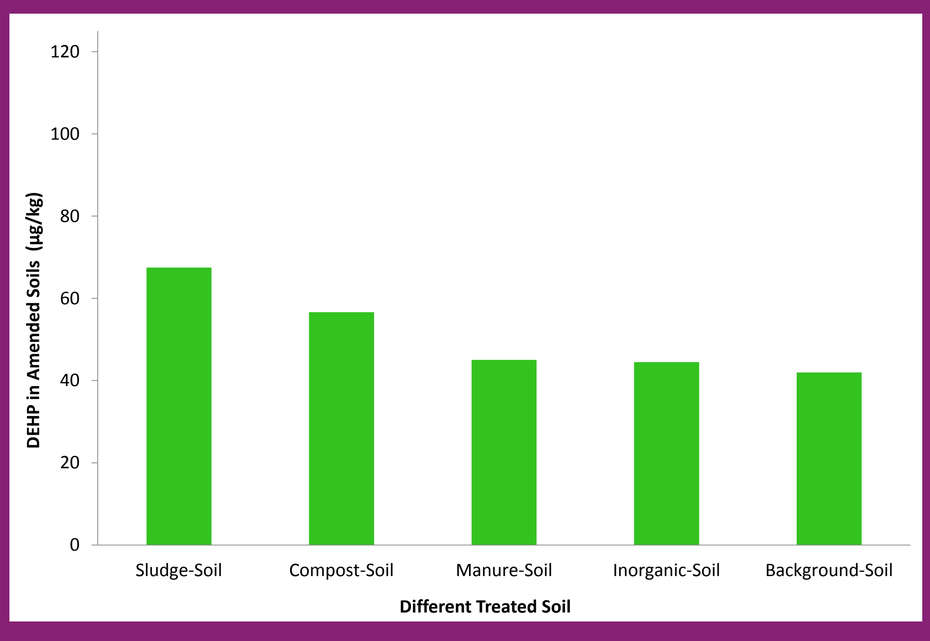

Figure 3 Measured-DEHP in Different Organic Wastes Treated Soils

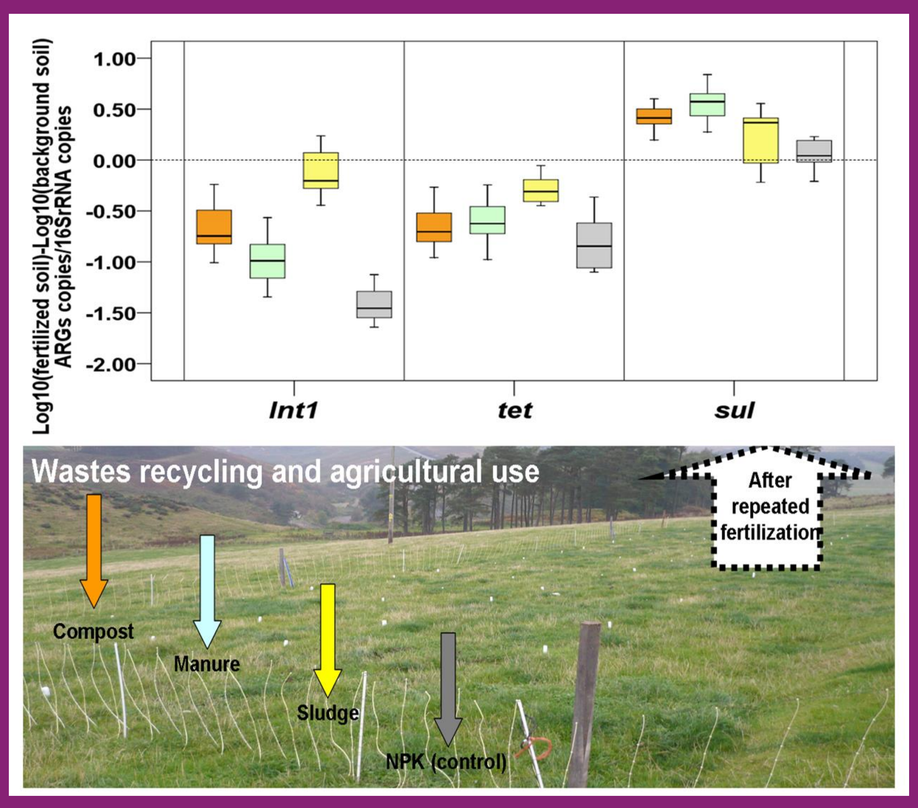

Figure 4 Soil ARGs Changes over Different Organic Wastes Treatment

Acknowledgements
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