



The interaction between soil erosion and soil organisms in temperate agroecosystems: nematode redistribution in tramlines

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Arable agriculture presents a unique set of challenges, and one of the most important is soil erosion. Whilst policy and practice look towards sustainable intensification of production to ensure food security, fundamental gaps in our understanding still exist. The physical processes involved in the detachment, transport and deposition of soil are well characterised but further research considering chemical and nutrient transport, fertiliser and pesticide losses, and environmental impacts to downstream environments is still required. Furthermore the interaction between soil erosion and soil organisms have largely been ignored, even though soil organisms serve a myriad of functions essential in the provision of soil ecosystem goods and services. Here we present the findings of a field-scale experiment into soil biotic redistribution undertaken at the James Hutton Institute's Balruddery Farm, Scotland (Link Tramlines Project XDW8001). Farm vehicle-tyre wheelings left in arable fields (tramlines) to enable crop spraying during the crop growth cycle have been identified as key transport pathways for sediment and associated nutrients. We tested the hypothesis that soil organisms were also transported by tramline erosion. During the winter of 2012/13 an experiment was undertaken to measure soil organism export from unbound hillslope plots subject to four different tramline treatments set out in a randomised block design. We used soil nematodes as a model organism as they are ubiquitous and sensitive to disturbance and an established indicator taxa of biological and physico-chemical changes in soil. Tramline treatments included a control tyre (conventional tractor tyre), a control tyre with a sown tramline, a low pressure tyre with sown tramline, and a control tyre with a spiked harrow. Post-event sampling of rainfall events was undertaken, and a range of variables measured in the laboratory. The spiked harrow treatment produced the greatest overall reductions in nematode export with 95% less nematodes exported, compared with the control treatment. We observed wholesale non-selective transport of all nematode trophic groups present in the soil. The findings of this experiment are twofold. Firstly, we demonstrate that soil organisms are transported by erosion processes and confirm that tramlines are key hydrological pathways. Secondly, we highlight practical on-farm solutions that have potential to decrease soil organism losses. These results provide important baseline information to improve our understanding of soil erosion impacts to the wider soil ecosystem. The results help to inform soil and water conservation measures for sustainable agriculture.