Geophysical Research Abstracts
Vol. 12, EGU2010-13342-1, 2010
EGU General Assembly 2010

Operational methods for minimising soil compaction and diffuse pollution risk from wheelings in winter cereals

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Recent UK government-funded research has shown that compacted, unvegetated tramlines wheelings can represent an important source and transport pathway, which can account for 80% of surface runoff, sediment and phosphorus losses to edge-of-field from cereals on moderate slopes. For example, recent research found 5.5-15.8% of rainfall lost as runoff, and losses of 0.8-2.9 kg TP/ha and 0.3-4.8 T/ha sediment from tramline wheelings. When compaction was released by shallow cultivation, runoff was reduced to 0.2-1.7% of rainfall with losses of 0.0-0.2 kg TP/ha and 0.003-0.3 T/ha sediment respectively i.e. close to reference losses from control areas without tramlines. Recent independent assessments using novel tracer techniques have also shown that tramline wheelings can represent important sediment sources at river catchment scale.

In response to these latest findings, a new project is now underway investigating the most cost-effective and practical ways of operationalising methods for managing tramline wheelings in autumn-sown cereal systems to reduce the risk of soil compaction from the autumn spray operation and the associated risk of surface runoff and diffuse pollution loss of sediment, phosphorus and nitrogen to edge of field. Research is focusing on the over-winter period when soils are close to field capacity and the physical protection of the soil surface granted by growing crop is limited.

This paper outlines this new multi-disciplinary project and associated methodologies, which include hillslope-scale event-based evaluations of the effectiveness of novel mitigation methods on surface runoff and diffuse pollution losses to edge of field, assessments of the economic and practical viability of mitigation methods, and modelling the impact on water quality of implementation of the most promising techniques at both farm and catchment scale. The study involves a large consortium with 20 partners, including many industrial organisations representing tractor, crop sprayer, cultivator and tyre manufacturers, and the associated development and evaluation of novel tools for sustainable land management.

Preliminary results from the first winter of monitoring focus on soil physics assessments (such as surface roughness, near-surface compaction, bulk density) and event-based losses associated with surface runoff. Research is initially investigating the relative importance of soil compaction, rather than the lack of vegetation cover, in accounting for the much greater losses of surface runoff, sediment and P loss identified down tramline wheelings compared to the uncompacted, cropped area. Treatments being investigated on three sites with contrasting soil textures and climatic regimes include:

• The effect of correctly inflated, “Xeobib” low ground pressure tractor and sprayer tyres compared to conventional tyres and “common practice” tyre pressures
• The effect of drilling the wheeling areas and using new GPS technology to guide spraying operations, compared to conventional practice of using undrilled tramline areas for that purpose.

Subsequent monitoring periods will explore the cost-effectiveness of techniques to lift the soil compaction in the autumn using novel tools attached to the sprayer unit.

Results from such applied, field scale cost-effectiveness studies provide evidence to help identify source areas of diffuse pollution, improve our process understanding of the response of soil systems to land management practices, and thereby support the targeting of practical pollution control measures across a range of soil types and

climatic regimes. This project will provide practical recommendations to the farming industry, help inform farm scale evaluations of diffuse pollution risk such as the new Soil Protection Review recently introduced by the UK Department for the Environment Food and Rural Affairs (Defra), and yield data to help parameterise and refine diffuse pollution models used for policy support at a range of scales.