WaterProtect: towards sustainable herbicide use

The Irish section of a major European research project will examine pathways of herbicide movement in an Irish field setting to ascertain its occurrence in water sources.

Modern agricultural practices use herbicides throughout most phases of grass and crop growth to maintain and increase productivity. However, some herbicides can be leached or washed off soil surfaces, and can eventually be detected in drinking water sources. MCPA, used to control rush and broadleaf weed growth, can be particularly mobile once applied. Key questions are:

1. Do we understand enough about this process of herbicide loss to water?
2. Do current practices require modification to minimise this loss?

The EU Horizon 2020 project WaterProtect, running from June 2017 until May 2020, aims to address these questions. The project is a large collaboration between seven case studies located in Belgium, Denmark, Spain, Poland, Romania, Italy and Ireland. The Irish case study is led by Teagasc, with Wexford County Council, Glanbia Ingredients Ireland Ltd and Ulster University working as partners. The Irish research will focus on assessing the transport pathways and behaviour of herbicides, with a special focus on MCPA applied to an Irish field site, and the usefulness of specific measures for mitigating the losses to aquatic systems. Two other EU-funded projects, Horizon 2020 'Fairways', which includes a Northern Ireland case study, and INTERREG VA 'Source to Tap', an exclusively cross-border Irish project, are addressing different aspects of sustainable herbicide use. The investment in three large-scale projects across Ireland relating specifically to sustainable MCPA use is an indication of how important this topic has become.

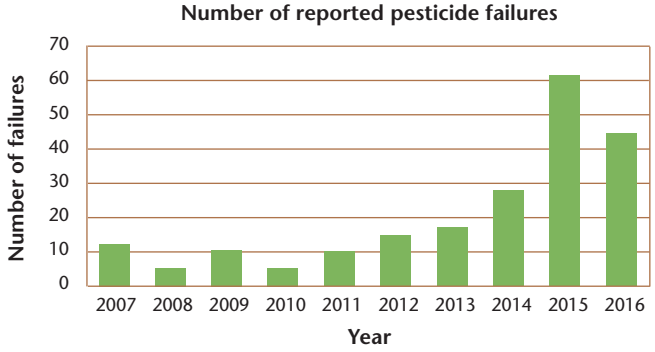

FIGURE 1: Number of public water supplies with reported pesticide failures (EPA, 2017).

Pesticides – usage and environmental occurrence

From the most recent estimates, 78 and 114 active substances are in use in grassland/fodder and arable crops in Ireland, respectively (PCD, 2012; PCD, 2013). In terms of weight, this corresponds to approximately 600 tonnes and 1,150 tonnes, respectively, of active substances being applied to grassland/fodder crops and arable crops annually. While legislative steps have been enacted to govern the control and use of pesticides, monitoring of drinking water resources has shown an increase in the number of public water supplies that are failing to meet the legislative standards (**Figure 1**). At the end of 2016, 63 supplies serving over 900,000 people had open investigations due to failures to meet the acceptable pesticide quality standard stipulated by the legislation (EPA, 2017). While these observed failures relate to all pesticides, monitoring has illustrated that MCPA is mostly responsible for the exceedances. Failures were mostly evident during May, June and July, and again in September/October, which typically coincide with periods of MCPA application to grassland for the control of rush, ragwort and thistle (*ibid*). Pesticides can enter water bodies via a number of pathways, including surface run-off, erosion, leaching, drain flow and spray drift. The movement and fate of pesticides in the environment via these pathways depends on many factors including the soil type and structure, subsoil geology, soil pH, soil microbiology, soil moisture, application timing and pesticide formulation. MCPA in particular has been shown to have the potential to be highly mobile in the environment post application due to its high water solubility and low sorption with the soil, which is consistent with its detection in drinking water sources.

Due to the number and varied nature of potential pathways, a considerable number of mitigation measures have been investigated (vegetative buffers, riparian buffers, constructed wetlands, spray drift reduction, etc.), albeit with varying success. The WaterProtect research aims to assess the pathways of herbicide movement, particularly MCPA, in an Irish field setting. A greater understanding of pathways is required for evaluating risks to drinking water resources, and is necessary to identify potential mitigating factors.

WaterProtect: Irish research

The research will be conducted in two agricultural catchments in Wexford that have been monitored extensively as part of the Agricultural Catchments Programme (ACP) (**Figure 2**).
One catchment has mostly free draining soils with arable crops, and the other has mostly poorly drained soils and is dominated by grassland for beef and dairy production.
The research will investigate the occurrence of MCPA in groundwater through the sampling of private water wells in both study areas. Approximately 162,000 households in Ireland rely on private wells for their water provision (CSO, 2012); hence, it is important that this water is of appropriate quality. This investigation will assess seasonal well water quality and also the importance of groundwater as a receptor and pathway for pesticide contamination. On a field scale, the study will then focus on MCPA and its behaviour and fate post application for rush control treatment in a poorly draining impermeable grassland field (**Figure 2**). Once applied, monitoring will evaluate its movement via subsurface drains, shallow groundwater, overland flow and surface water streams. This will be achieved through the use of high-resolution monitoring as well as passive samplers, which are capable of providing overall average concentrations of MCPA lost via surface water streams.
Combined with case studies across the EU, and with partner projects in Ireland, the results will provide a new knowledge base for policies and management practices relating to sustainable MCPA use into the future.

Acknowledgments

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 727450. Disclaimer: this publication only reflects the authors' views and the Commission is not responsible for any use that may be made of the information it contains.

References

Central Statistics Office (CSO). (2012). 'Profile 4: The Roof Over our Heads.' Available from: www.cso.ie/en/media/csoie/census/documents/census2011profile4/Profile_4_The_Roof_over_our_Heads_Full_doc_sig_amended.pdf.
Environmental Protection Agency. (2017). 'Drinking Water Report for Public Water Supplies 2016.' Johnstown Castle, Wexford.
Pesticide Control Division (PCD). (2012). 'Pesticide Usage in Ireland. Arable Crops Survey Report 2012.' Department of Agriculture, Food and the Marine.
Pesticide Control Division (PCD). (2013). 'Pesticide Usage in Ireland. Grassland and Fodder Crops Survey Report 2013.' Department of Agriculture, Food and the Marine.

FIGURE 2: Overview of the grassland catchment and evidence of overland flow after a rainfall event on a poorly drained field where MCPA would typically be used for rush control.

Authors

Chris Fennell
Postdoctoral Researcher, Teagasc Environment Research Centre, Johnstown Castle, Co. Wexford.
Correspondence: chris.fennell@teagasc.ie

Per-Erik Mellander
Senior Research Officer, Catchment Science, Agricultural Catchments Programme, Teagasc Environment Research Centre, Johnstown Castle, Co. Wexford.

Owen Fenton
Principal Research Officer, Teagasc Environment Research Centre, Johnstown Castle, Co. Wexford.

Phil Jordan
Professor of Catchment Science, School of Geography and Environmental Sciences, Ulster University