SIXTH FRAMEWORK PROGRAMME

FOOTPRINT

Functional Tools for Pesticide Risk Assessment and Management

Mitigation strategies and their effectiveness

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Introduction

- The contamination of water bodies with agricultural pesticides can pose a significant threat to aquatic ecosystems and drinking water resources. However, the risk for the aquatic community or for human health can often be substantially reduced by appropriate measures.
- Mitigation of pesticide inputs into water bodies includes both reduction of diffuse-source (runoff and erosion, tile drainage, spray drift, leaching to groundwater) and of point-source inputs, which in some regions of Europe have been shown to make a highly significant contribution to the observed pesticide loads in rivers.
- The current knowledge on mitigation strategies to reduce pesticide inputs into surface water and groundwater, and their effectiveness when applied in practice was reviewed.

Aims of the present review were

- estimating the efficiencies of the various mitigation measures at the farm scale for different combinations of pesticide properties, soil and climate,
- assessing the effects at the regional/catchment scale due to the implementation of a given mitigation measure,
- assessing the effects of realistic combinations of mitigation measures at regional/catchment scale,
- evaluating the mitigation strategies identified in the literature with respect to their practicability, and recommending those considered both effective and feasible for implementation at the farm and catchment scale,
- providing recommendations for modelling using the identified reduction efficiencies.

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Results and discussion

- Roughly 180 publications directly dealing with or being somehow related to mitigation of pesticide inputs into water bodies were examined. Both original studies and reviews were most numerous for the input path runoff and erosion. However, not all experimental studies were usable for quantitative evaluation.
- There are considerably more mitigation measures (and literature on mitigation) available for the pathways surface runoff / erosion and spray drift than for drainage and leaching.
- Of all mitigation measures, vegetated buffer strips for mitigating pesticide runoff and erosion inputs into surface water have received the largest attention in the literature.

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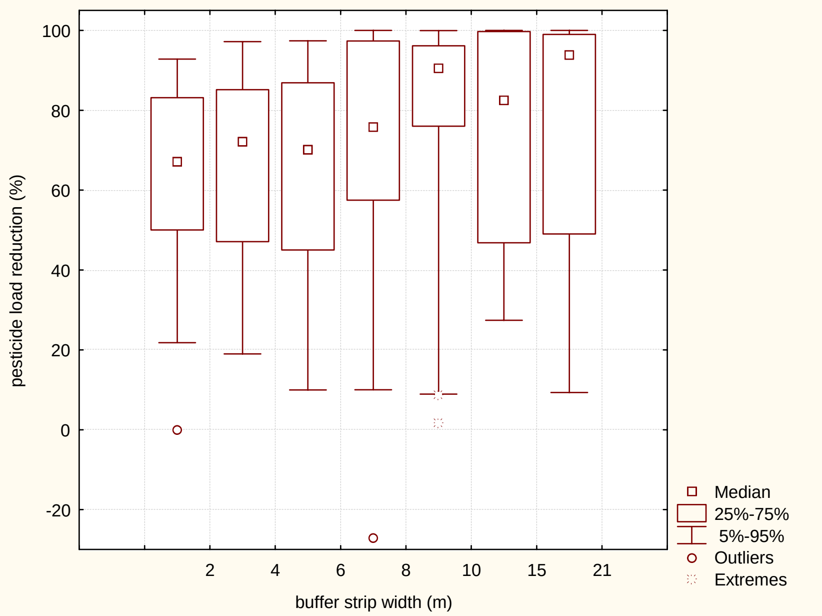
Runoff/erosion

- The effectiveness of grassed buffer strips located at the lower edges of fields has been demonstrated in general. However, this effectiveness is very variable, and the variability cannot be explained by strip width alone.
- Riparian buffer strips are most probably much less effective than edge-of-field buffer strips in reducing pesticide runoff and erosion inputs into surface waters.
- Constructed wetlands are promising tools for mitigating pesticide inputs via runoff/erosion and drift into surface waters, but their effectiveness still has to be demonstrated for weakly and moderately sorbing compounds.
- Pesticide runoff and drainage losses are mutually dependent. Subsurface drains are an effective mitigation measure for pesticide runoff losses from slowly permeable soils with frequent waterlogging.

Pesticide load reduction efficiencies of edge-of-field buffer strips vs. classified buffer strip width (n = 277)



Drainage and leaching

> Reported mitigation measures available for the pathways drainage and leaching are very limited in comparison to those available for runoff/erosion and spray drift.

> The effects of pesticide formulation, tillage operations and pesticide incorporation into the soil on pesticide losses via drainage and leaching are insufficiently known and at best unpredictable. These measures are therefore not suitable for recommendation as mitigation measures for pesticide losses via drainage or leaching.

> This leaves rate reduction, product substitution and shift of the application date as only feasible mitigation measures for both pathways.

> For drainage, the use of collection ponds for drain outflow analogously to constructed wetlands seems a further possible alternative, but there are no experimental data available so far on their effectiveness.

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Spray drift

> There are many possible effective measures of spray drift reduction (e.g. drift-reducing nozzles, no-spray buffers, windbreaks, spray additives, air assistance etc.) and also many possibilities of combining two or more measures.

> While sufficient knowledge exists for suggesting default values for the efficiency of single measures, little information exists on the effect of the drift reduction efficiency of combined measures.

> More research on possible interactions between different drift mitigation measures and the resulting overall drift reduction efficiency is therefore indicated.

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Point sources

- Point-source inputs can be mitigated against by increasing awareness of the farmers with regard to pesticide handling and application, and encouraging them to implement loss-reducing measures of "best management practice" (e.g. filling and cleaning sprayers only on the field or on biobeds, careful handling and storage of pesticides, applying leftovers in dilute form on the field, no application of pesticides on the farmyard etc.).
- Information and advisory campaigns and trainings were successful and effective in most study catchments, but continuous effort is necessary to maintain farmer awareness and prevent backsliding.
- In catchments dominated by diffuse inputs at least in some years, mitigation of point-source inputs alone may not be sufficient to reduce pesticide loads/concentrations in water bodies to an acceptable level.

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Outlook

- Discussions ongoing to see how the results of the present review work will be integrated in the FOOT tools used at the local (FOOT-FS) and the catchment/regional scale (FOOT-CRS)

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