Sources and measures to reduce pollution of pesticides


Study area

The landscape of alluvial deposits (fig.1) along river Glomma, the largest river in Norway, provides good conditions for potato production and represents a main area for potato production in Norway.

Figure 1. Large amount of fluvial deposits suitable for potato production (Photo J. Kiærner).

In most of the area soils consist of a 40-100 cm thick layer of silt loam above sand (table 1).

Table 1. Soil layering in the study area (Kiærner et al. 2004)

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Layer Depth (cm)</th>
</tr>
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<tbody>
<tr>
<td>Silt loam</td>
<td>40-100</td>
</tr>
<tr>
<td>Sand</td>
<td>Below 40</td>
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Because of the high groundwater level influenced by the river, the aquifer can be easily used as local water supplies of households.

Pesticide monitoring

Groundwater samples from ten sites were analysed for pesticides in 1999/2000 (n=3). The same locations were reinvestigated in 2015/2016 (n=4).

The following pesticides were detected from the period in 1999/2000: BAM, bentazone, metribuzin, metalaxyl, MCPA, 2,4-D and ETU. From the last period 2015/2016: BAM, cyazofamid, glyphosate, imidacloprid, metribuzin, IN7942, and IN79424 (degradation products from rimsulfuron).

Sources of pesticide pollution

Based on frequency of occurrence and monitoring of the pesticides, modelling of pesticide leaching, registrations of washing sites for pesticide spraying equipment and groundwater flow patterns, assumption of the different sources of pollution was estimated

• Point sources

Relatively high concentrations of pesticides might be due to point sources caused by seed treatment, filling operations or cleaning of sprayers and boxes for storing potatoes. These pesticides were: BAM, glyphosate, ETU, metribuzin, metalaxyl and imidacloprid.

• Diffuse sources

Occurrence of pesticides or degradation products distributed on large areas might be due diffuse sources. Especially degradation products from rimsulfuron occur in all sites in the last period 2015/2016.

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Measures

To prevent pollution, different mitigations were tested by the stakeholders. A biofilter was installed, risk tables, maps and web-based calculators were demonstrated.

• Biofilter

At one farm as a pilot project for demonstration and monitoring a biofilter was installed to protect groundwater and avoid point sources. An impermeable bunded sprayer fill area with required fall was drained to a silt trap and liquid collector/chamber (fig.2).

Figure 2. Construction of the sprayer fill area with drainage to the silt trap and liquid container (Photo K. Sørensen).

From this container a pump transferred the liquid from the platform to the highest container. This is a classical biofilter with three containers mounted one above the other connected to each other to allow drainage and recirculation from a liquid collection at the bottom supplying the highest container (fig.3). The containers were filled with biofilm which is compost, soil and straw (1:1:2).

Figure 3. Containers filled with biofilm and stacked to allow gravity flow and recirculation (Photo I. Næss).

• Risk tables

Risk tables (table 2) were demonstrated and tested among involved farmers. These tables contained information of concentration of the pesticides in ground water simulated with MACRO-DB (Elko et al., 2009). Soil maps was combined with risk tables necessary to make the farmers able to make their choices of pesticides.

Table 2. Risk tables of pesticides used in spring cereals and table of soil types (Elko et al., 2009).

<table>
<thead>
<tr>
<th>Pesticide Name</th>
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<tr>
<td>BAM</td>
<td>High</td>
</tr>
<tr>
<td>Glyphosate</td>
<td>Medium</td>
</tr>
<tr>
<td>ETU</td>
<td>Low</td>
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• Risk maps

GIS based risk maps based on simulations with MACRO-DB combined with soil maps (fig. 4.) is an other way to present risk tools to support users.

Figure 4. GIS map estimating risk of groundwater pollution of pesticides on different soil types (Elko et al., 2009).

• Web-based risk calculator

A step further is a new internet-based tool SYNOPS-WEB (Dominic et al., 2017) which calculate exposure toxicity ratio (ETR) for different field scenarios of pesticide (Dominic et al., 2017).

Figure 5. SYNOPS-WEB, an internet based tool for calculating the exposure toxicity ratio ETR for different field application scenarios of pesticide (Synops et al., 2017).

References:


Monitoring of pesticides in groundwater have documented point sources and diffuse pollution from agriculture. Biofilters to avoid point sources has been installed and tools to select pesticides have been tested to reduce diffuse pollution. Site specific information and knowledge about soil and climate combined with pesticide properties are still a challenge to prevent environmental pollution and experience with stakeholders have demonstrated still needs of available knowledge about pesticide risk of pollution. Validation of models and development of userfriendly tools are still needed.