New BMPs on Drainage and Leaching

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Outline

• Context for Developing & Using the New BMPs
• Factors Affecting Pesticide Movement & Its Diagnosis
• The BMP Measures
  – Pesticide Use Practices
  – Agronomic Practices
  – Drainage & Irrigation Practices
• Conclusion & Next Steps
Context for Developing & Using the New BMPs

- Key to completing the ‘TOPPS umbrella’ for water protection
- The aim is to meet society’s expectations for clean water by reducing pesticide movement down soil profiles where unacceptable
- BMPs cover two kinds of pesticide movement with water in soil profiles:
  - **Drainage:** via artificial drains to surface water
  - **Leaching:** down to groundwater
- Water protection mostly achieved by strict EU regulatory procedures
- Unacceptable movement sometimes occurs at the extremes
  - Product use patterns & pesticide movement potential
  - Local soil & climate characteristics + field management practices
Context for Developing & Using the New BMPs

When should the Drainage and Leaching BMPs be implemented?

<table>
<thead>
<tr>
<th>Reactively</th>
<th>Pro-Actively</th>
</tr>
</thead>
<tbody>
<tr>
<td>• When unacceptable movement occurs</td>
<td>• Before unacceptable movement occurs</td>
</tr>
<tr>
<td>• Focus on pesticide use BMPs</td>
<td>• Focus on agronomy BMPs etc.</td>
</tr>
<tr>
<td>• Improve conventional agriculture</td>
<td>• Support sustainable agriculture</td>
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<tr>
<td>• Product stewardship</td>
<td>• Land stewardship</td>
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</tbody>
</table>
Factors Affecting Pesticide Movement & Its Diagnosis

- **Pesticide factors** – determined partly by use rates & strongly by movement potential
- **Climate factors** – drive pesticide movement (total rainfall) & rates of degradation (temperature)
- **Soil hydrology** – different soil & water scenarios for drainage & leaching (for unacceptable findings pesticide-climate factors implicit)

Soil hydrology diagnosis needed to limit pesticide movement
## Factors Affecting Pesticide Movement & Its Diagnosis

### Pesticide movement vulnerability decision trees: Drainage

- **Factors:** drainage type, cracks, subsoiling, % clay, WHC

### Decision Tree

<table>
<thead>
<tr>
<th>Drainage due to low-permeability soil</th>
<th>Large cracks/macropores' occur</th>
<th>Subsoiling or moling done</th>
<th>High risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Large cracks/macropores do not occur in most years</td>
<td>No subsoiling or moling done</td>
<td>Clay &gt;35%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High risk</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Clay 25 to 35%</td>
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<td></td>
<td></td>
<td></td>
<td>Medium risk</td>
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<td></td>
<td></td>
<td></td>
<td>Clay &lt;25%</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Low risk</td>
</tr>
<tr>
<td>Drainage to control shallow groundwater</td>
<td>Mineral soil</td>
<td>Large cracks/macropores occur</td>
<td>High risk</td>
</tr>
<tr>
<td></td>
<td>Large cracks/macropores do not occur in most years</td>
<td>WHC &lt;150 mm</td>
<td>High risk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WHC 150–230 mm</td>
<td>Medium risk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WHC &gt;230 mm</td>
<td>Low risk</td>
</tr>
<tr>
<td>Peaty soil</td>
<td></td>
<td></td>
<td>Low risk</td>
</tr>
</tbody>
</table>

Decision tree co-developed by academia, technical institutes & industry
Factors Affecting Pesticide Movement & Its Diagnosis

Pesticide movement vulnerability decision trees: Leaching

- Factors: GW depth, cracks, soil type, no-till, WHC

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Large cracks/macropores² occur</th>
<th>Sowing under no-till</th>
<th>WHC³ &lt;150 mm</th>
<th>WHC of 150 to 230 mm</th>
<th>WHC &gt;230 mm</th>
<th>Peaty soil⁴</th>
<th>Shallow soil⁸ on fractured rock</th>
<th>Other soil</th>
</tr>
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<tbody>
<tr>
<td>Shallow¹ groundwater</td>
<td></td>
<td></td>
<td></td>
<td>High risk</td>
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<td>Other soil</td>
<td>Sowing under no-till</td>
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## The BMP Measures - Pesticide Use Practices

### What to do?

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<th>Types of BMP Measure</th>
<th>The BMP Measures</th>
</tr>
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</table>
| Adapt application timing                         | - Avoid applications shortly before heavy rainfall is forecast  
- Use split applications if possible (to spread the risk)  
- **Avoid applications in the drainflow / GW recharge season***  
- **Consider using alternative products*** |
| Reduce use rates / field                         | - Reduce applied rates within label conditions  
- Use seed treatment instead (doses normally lower)  
- Use pest monitoring to refine choice of product / AI  
- Use variable rates across fields if justified / feasible  
- **Use mixture products if feasible to manage pests*** |
| Optimise overall use rate across catchment area  | - Depends very strongly on the crop rotation  
- **Rotate pesticides used for individual crops in the rotation***  
- **Restrict pesticide applications in most vulnerable fields*** |

*Use reactively if there are unacceptable findings; others pro-actively*
The BMP Measures - Pesticide Use Practices

How to do it?

• Check product labels / weather forecasts
• Check with product stewardship advisors, e.g. agronomists

Look to the Future & Go Digital by Following Investments in:

• Mapping tools over *which fields* to apply to due to vulnerability
• Decision support tools over *when* to apply due to pest risks
• Precision technology over *which parts of fields* to apply to
## The BMP Measures - Agronomic Practices

### What to do?

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| Optimise crop rotation | Select crop rotations to include optimisation of crop health  
• Alternate winter and spring crops on fields  
• Alternate crops with tap and fibrous root systems |
| Grow cover crops | Select cover crops to fit crop rotation & benefit farmers  
• Brassicas (mustards, raddishes, turnips)  
• Legumes (vetches, clovers)  
• Grasses & cereals (oats, rye, ryegrass) |
| Adapt tillage in soils with large cracks / macropores | If drainage or leaching is an issue, then consider using  
• **Shallow tillage on vulnerable fields to reduce the impact*** |

¹All highlighted in the Sustainable Use Directive as core to IPM

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The BMP Measures - Agronomic Practices

- **Why do it?** To work more productively with Ecosystem Services
  - Optimise Crop Rotation, Including Cover Crops & Adapt Tillage
  - IPM & soil health
  - Explores soil resources fully
  - Sustainable cropping
  - Helps recycle nutrients
  - As little as possible, but as much as necessary
  - Cover crops feed soils

- **Why not do it?** If costs > benefits. Too complex. Time consuming.
The BMP Measures – Drainage & Irrigation Practices

- **What to do?**

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| Drainage             | Design drainage systems to avoid over-drainage  
  - Get advice to install primary drainage systems (~decades)  
  - Amend secondary drainage system practices (~5 years) |
| Drainage Retention   | Use retention structures (ponds, wetlands) if there are issues* |
| Irrigation           |  
  - Optimise scheduling - modern precision practices to meet crop water needs (real time needs vs. calendar estimation)  
  - Amend pesticide use if there are issues (design integrated practices for product application / irrigation)* |

*Use reactively if there are unacceptable findings; others pro-actively
Conclusion & Next Steps

Conclusion

• New drainage & leaching BMP framework defined
• Relevant to drinking water providers to deliver clean water

Next Steps

• Raise awareness & start implementing framework
• Start changing practices as necessary
  – **Pesticide Use:** amend use pattern thinking
  – **Agronomy:** add ecosystem services thinking
  – **Drainage & Irrigation:** use it, don’t lose it
• Help farmers move to Sustainable Agriculture step-by-step
Thank you for your attention!

And to the drainage & leaching project team:

- Professor Colin Brown, York University, UK
- Jeremy Dyson, Syngenta, Basel CH
- Professor Aldo Ferrero, University of Turin, IT
- Professor Roland Kubiak, RLP Agroscience, DE
- Volker Laabs, BASF, Limburgerhof DE
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- Manfred Röttele, BetterDecisions DE
- Robin Sur, Bayer, Monheim DE
- Matthias Trapp, RLP Agroscience, DE