A biological system to mitigate the pesticide point contaminations

G. Fait

M. Nicelli, J. Fragoulis, M. Trevisan and E. Capri
Background

Pesticides are already highly regulated under the Directive 91/414/EEC.

The Water Framework Directive (WFD) expands the scope of water protection to all waters and it is intended to bring an integrated and coordinated framework for the sustainable management of all waters and requires them to achieve “good status” by 2015

- implementing best practice measures
- minimizing the hazard and risk on human health and environment
- using low input pesticides
Sources of water contamination by pesticides

(Mason PJ, et al. 1999. Relative importance of point source contamination of surface waters: River Cherwell catchment monitoring study, Proc XI Symp Pestic Chem, 11-15 September, Cremona, Italy)
Point sources of water contamination by pesticides

- tank filling
- spillages
- leaks from faulty equipment
- washing and waste disposal
- soakaways and drainage
- direct contamination
- consented discharges

(Carter AD. 1999. Pesticide contamination of water sources and the monitoring data across the EU, Proc XI Symp Pestic Chem, 11-15 September, Cremona, Italy)

In Italy, for vineyard farms, it has been calculated an average value of 700L of water used to wash the spray equipment after each pesticide application; 60% of this waste water is distributed directly in the field or in the farmyard.
The Biobed development

In Sweden


In United Kingdom


The Biomassbed
Biomassbed mixture

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vine-branch</td>
<td>40%</td>
</tr>
<tr>
<td>Compost</td>
<td>40%</td>
</tr>
<tr>
<td>Topsoil</td>
<td>20%</td>
</tr>
</tbody>
</table>

C/N 28.7

Bulk density 525 g/l

Dimension parameters:

- fleet of cars (tractors, tanks)
- treatments (number, volume)
- volumes of final washing
## Pesticides Loading

<table>
<thead>
<tr>
<th></th>
<th>Number of application in 2003</th>
<th>Number of application in 2004</th>
<th>amount of a.i. entered in the biomassbed in 2003 (g)</th>
<th>amount of a.i. entered in the biomassbed in 2004 (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>cymoxanil</td>
<td>1</td>
<td>-</td>
<td>10.9</td>
<td>-</td>
</tr>
<tr>
<td>chlorpyrifos</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>25.0</td>
</tr>
<tr>
<td>cyprodinil</td>
<td>1</td>
<td>-</td>
<td>6.3</td>
<td>-</td>
</tr>
<tr>
<td>fenitrothion</td>
<td>1</td>
<td>1</td>
<td>27.5</td>
<td>48.3</td>
</tr>
<tr>
<td>fludioxonil</td>
<td>1</td>
<td>1</td>
<td>4.2</td>
<td>12.0</td>
</tr>
<tr>
<td>flufenoxuron</td>
<td>1</td>
<td>-</td>
<td>2.6</td>
<td>-</td>
</tr>
<tr>
<td>iprovalicarb</td>
<td>1</td>
<td>1</td>
<td>11.0</td>
<td>3.2</td>
</tr>
<tr>
<td>mancozeb</td>
<td>3</td>
<td>3</td>
<td>310.8</td>
<td>874.7</td>
</tr>
<tr>
<td>metalaxyl</td>
<td>2</td>
<td>2</td>
<td>12.6</td>
<td>37.3</td>
</tr>
<tr>
<td>penconazole</td>
<td>3</td>
<td>3</td>
<td>4.8</td>
<td>6.4</td>
</tr>
</tbody>
</table>
2003 load 12.6 g dissipated 100%
2004 load 37.3 g dissipated 99%

Fait G. Degree thesis. 2003
Santos C. Degree thesis. 2004
**mancozeb**

\[K_1 \ 0.074\]

\[K_2 \ 0.0018\]

\[Tb \ 30d\]

\[K_{\text{soil}} \ 0.005-0.116\]

\[K_{\text{hydr}} \ 0.46 \text{ at pH 5}
\ 0.30 \text{ at pH 7}
\ 1.04 \text{ at pH 9}\]
metalaxyl

$K_1 = 0.18$

$K_2 = 0.0154$

$T_b = 33d$

$K_{soil} = 0.017 - 0.069$

$K_{hydr} = 0.008$
Copper residue in water 2003-2004

2003 load 419g (87 %)
2004 load 385g (67 %)

LOD 1µg/l
**MASS BALANCE**

**metalaxyl (12.6 g)**
- Water: 97.5%
- Sediment: 2.2%
- Biomass: 0.3%

**fenitrothion (27.5 g)**
- Water: 58%
- Sediment: 1%
- Biomass: 40%

**iprovalicarb (11 g)**
- Water: 72%
- Sediment: 25%
- Biomass: 3%

**cimoxanil (10.9 g)**
- Water: 100%

MANCOZEB (311g)

MASS BALANCE

dissipated 97%

water 2%
COPPER (419 g)

MASS BALANCE

- biomass 81%
- sediment 17%
- water 2%
Conclusions

1) If used in the correct way, Biomassbed can mitigate pesticide point contaminations.

2) The Biomassbed performed very effectively retaining and/or degrading the pesticides (water decontamination 86-100% of the loading) and reducing the concentrations below the 0.1µg/l EU standard set for pesticides in drinking water.

3) Biomassbed is a closed system which avoid any risk of leaching of the water entered in the system.

4) Possibility to release the waters in SWB already after the first cycles (depending on pesticide)

5) Opportunities for using the Biomassbed as a tool for green/ecological certification of the farms.

6) Copper accumulate in the biomass, so it can represent a problem in the second year.