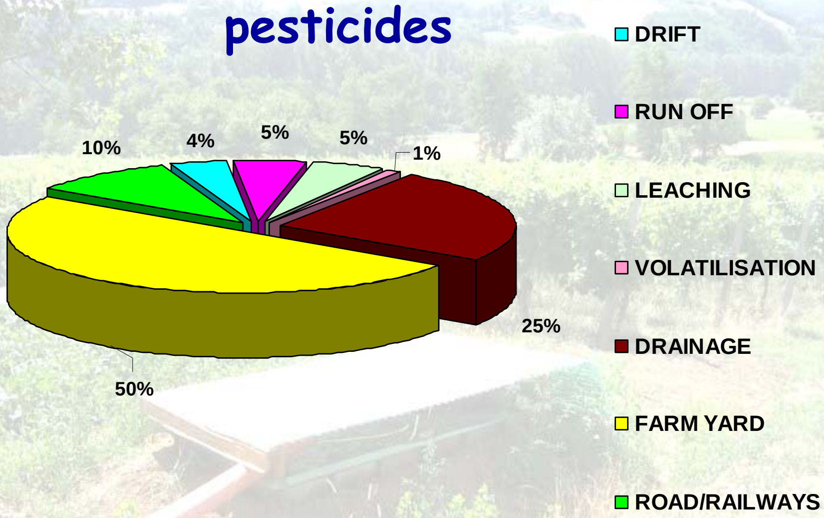
Background

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

<u>In Sweden</u>

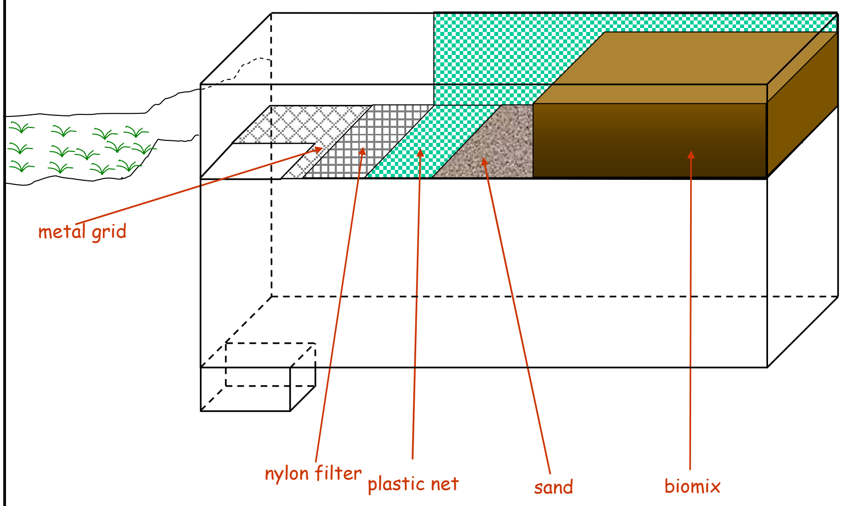
Torstensson L., et al. 1997. Use of biobeds in Sweden to minimise environmental spillage from agricultural spray equipment. Pesticide Outlook, 8: 24-27.
Torstensson L., 2000. Experiences of biobeds in practical use in Sweden. Pesticide Outlook, 11: 206-211.

<u>In United Kingdom</u>

Fogg P., et al. 2003. Degradation of pesticides in biobeds: the effect of concentration and pesticide mixture. J. Agric.Food Chem. 51: 5344-5349.
Fogg P., et al. 2003. Pesticide degradation in "biobed" composting substrate. Pest. Manag. Sci. 59: 527-537.
Fogg P., et al. 2004. Degradation and leaching potential of pesticides in biobed system. Pest. Manag. Sci. 60: 645-654.

Goals

1) to develop a system to mitigate water point-source contamination adapted to Italian conditions. The Biomassbed.
2) to demonstrate the ability of Biomassbed in decreasing the concentration of pesticides in waters coming from washing the spray equipment.
3) to measure the long term performances of the Biomassbed.



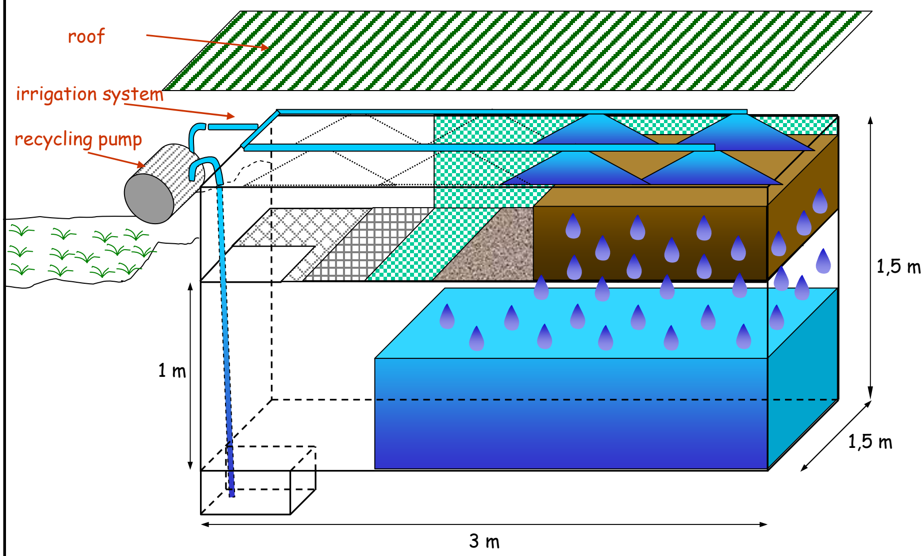
Biomassbed mixture

Vine-branch	40%
Compost	40%
Topsoil	20%

C/N 28,7

Bulk density 525 g/l

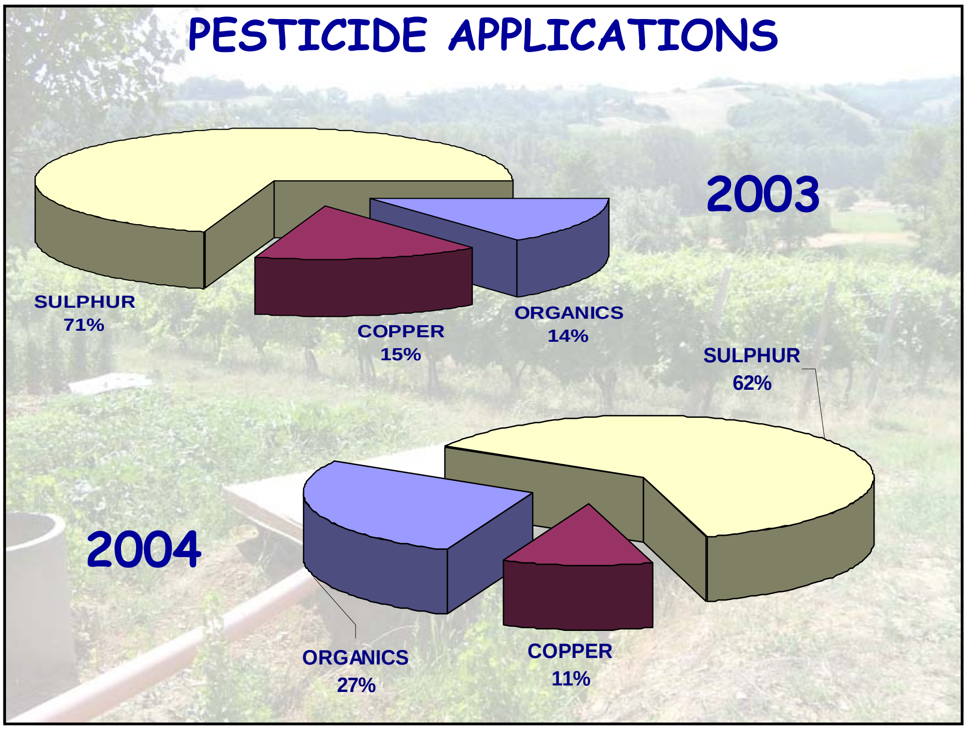
(Vischetti C., et al. 2004. Biomassbed: a biological system to reduce pesticide point contamination at farm level. *Chemosphere* 55:823-828)

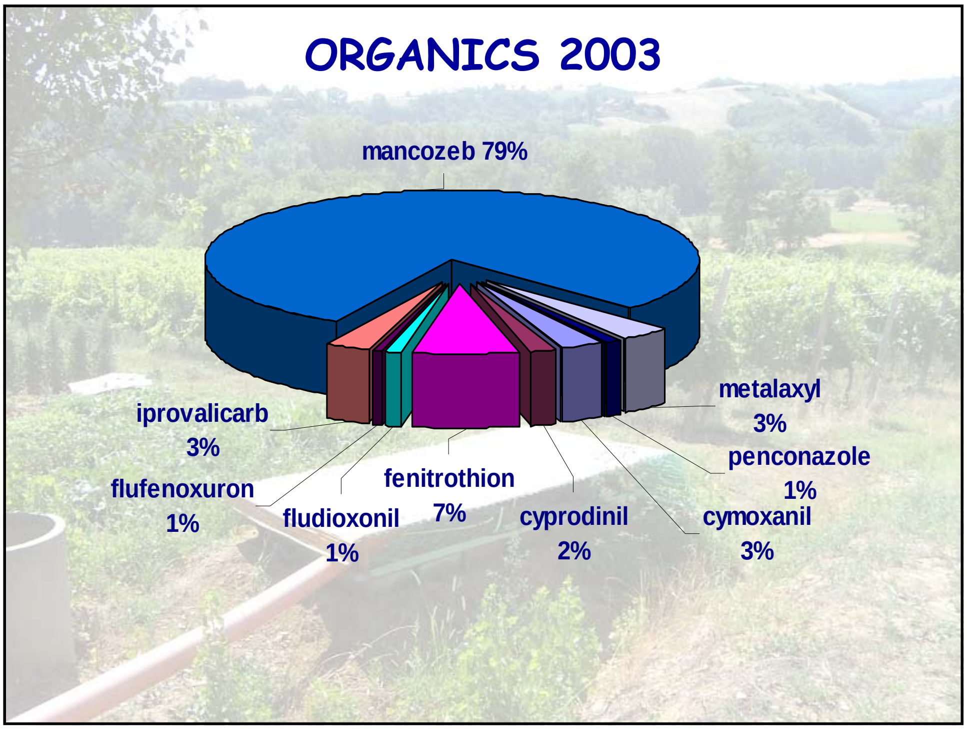


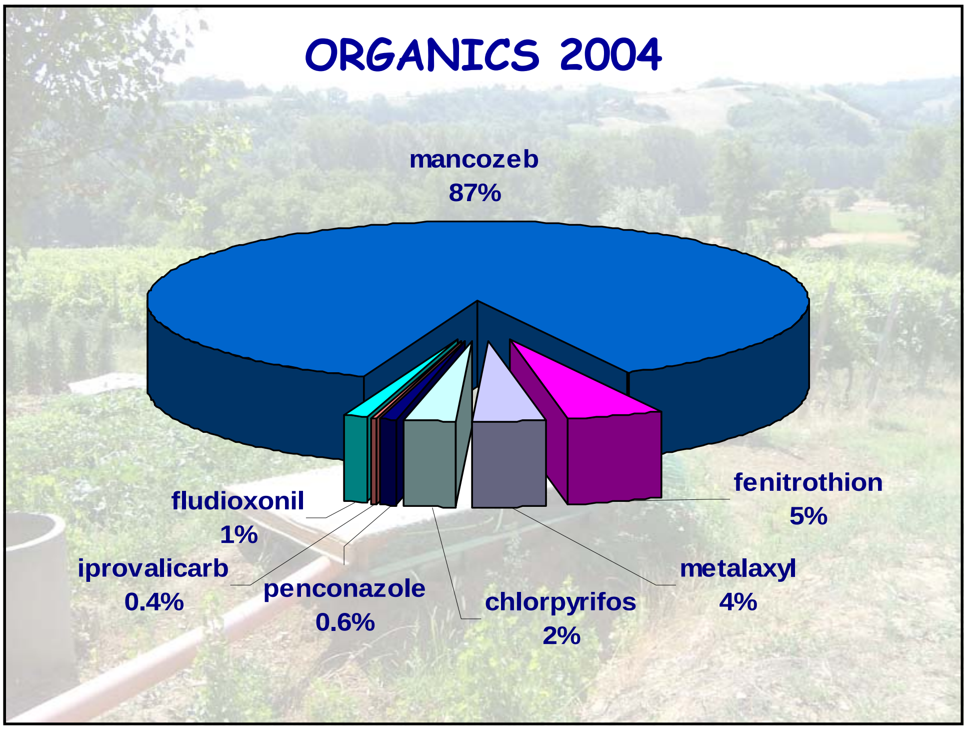
Dimension parameters:

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


27/03/2003


PESTICIDE APPLICATIONS
2003
SULPHUR
71%
COPPER
15%
ORGANICS
14%
SULPHUR
62%
2004
ORGANICS
27%
COPPER
11%

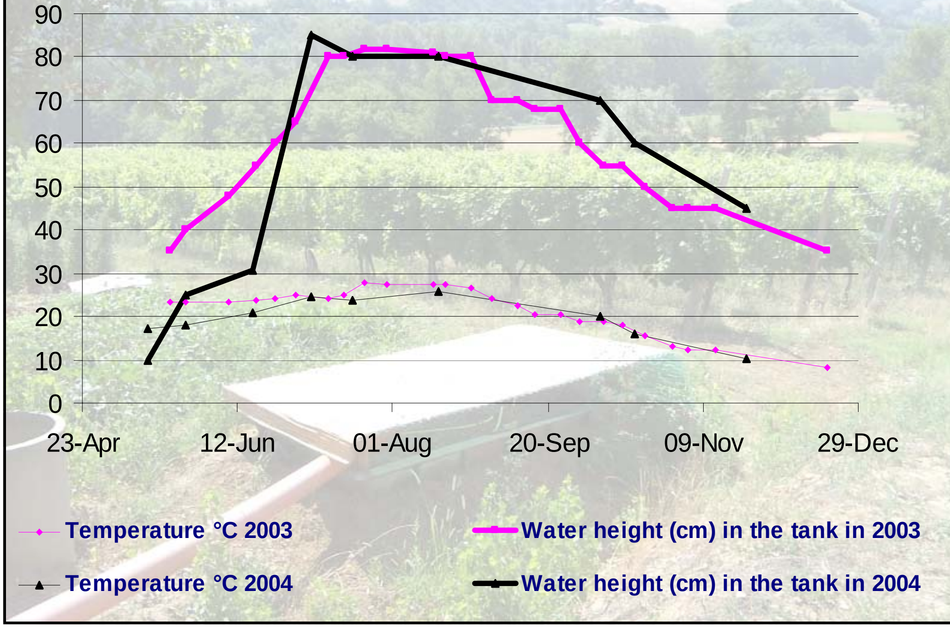

ORGANICS 2003
mancozeb 79%
iprovalicarb
3%
flufenoxuron
1%
fludioxonil
1%
fenitrothion
7%
cyprodinil
2%
cymoxanil
3%
penconazole
1%
metalaxyl
3%

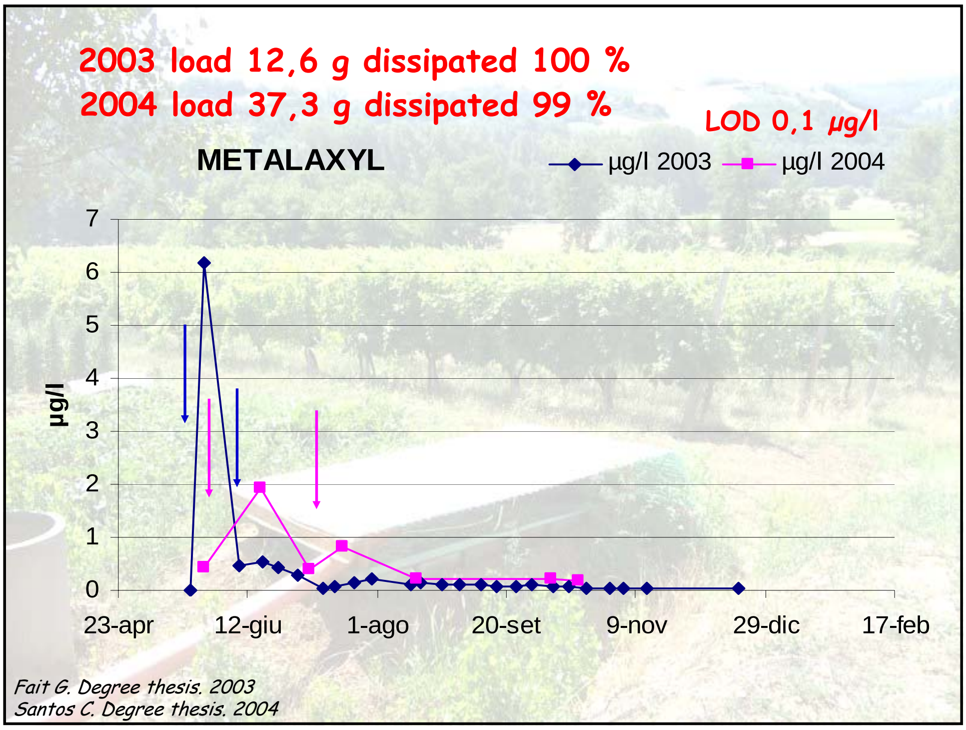

ORGANICS 2004
mancozeb
87%
fludioxonil
1%
iprovalicarb
0.4%
penconazole
0.6%
chlorpyrifos
2%
metalaxyl
4%
fenitrothion
5%

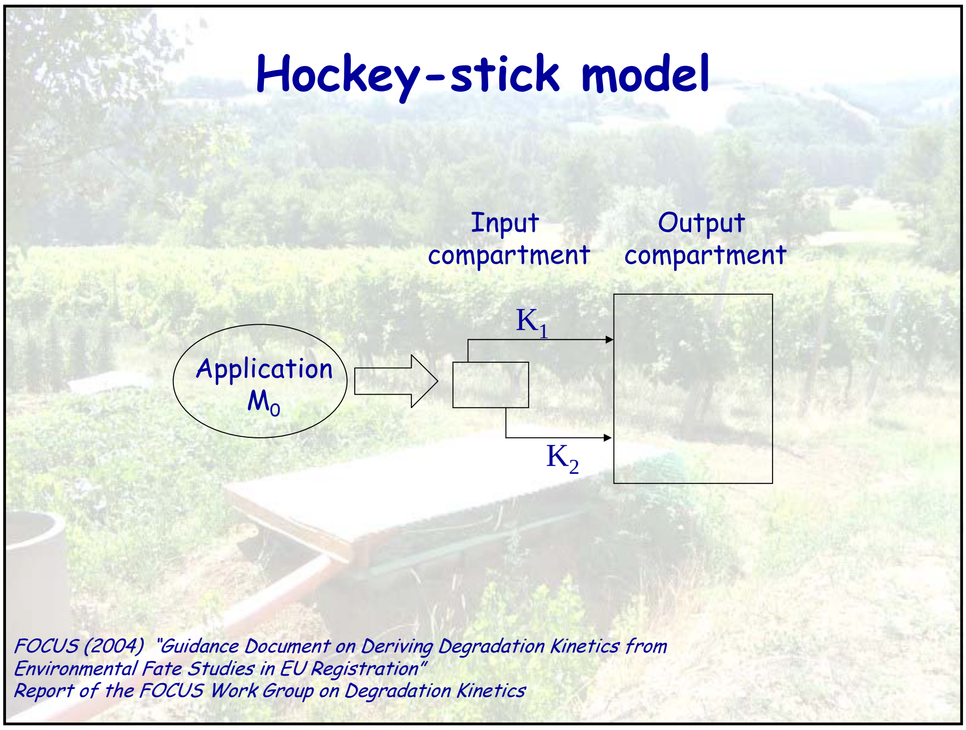
PESTICIDES LOADING

	Number of application in 2003	Number of application in 2004	amount of a.i. entered in the biomassbed in 2003 (g)	amount of a.i. entered in the biomassbed in 2004 (g)
cymoxanil	1	-	10.9	-
chlorpyrifos	-	1	-	25.0
cyprodinil	1	-	6.3	-
fenitrothion	1	1	27.5	48.3
fludioxonil	1	1	4.2	12.0
flufenoxuron	1	-	2.6	-
iprovalicarb	1	1	11.0	3.2
mancozeb	3	3	310.8	874.7
metalaxyl	2	2	12.6	37.3
penconazole	3	3	4.8	6.4

WATER AND TEMPERATURE




2003 load 12,6 g dissipated 100 %
2004 load 37,3 g dissipated 99 %
LOD 0,1 µg/l
METALAXYL
µg/l 2003
µg/l 2004
µg/l
7
6
5
4
3
2
1
0
23-apr
12-giu
1-ago
20-set
9-nov
29-dic
17-feb
Fait G. Degree thesis. 2003
Santos C. Degree thesis. 2004


Hockey-stick model
Input compartment
Output compartment
Application M_0
K_1
K_2
FOCUS (2004) "Guidance Document on Deriving Degradation Kinetics from Environmental Fate Studies in EU Registration"
Report of the FOCUS Work Group on Degradation Kinetics

PESTICIDES CHARACTERISTICS

	water solubility (mg/l)	*Koc*	*Henry's constant law ($Pa*m^3*mol^{-1}$)*	*vapour pressure (mPa)*	*DT50 in soil (d)*
fenitrothion	14	2000-7150	0.246	18	12-28
mancozeb	6.2	6000	$5.9*10^{-4}$	<0.0133	6-139
metalaxyl	8,400	30-300	$1.6*10^{-5}$	0.75	10-40
penconazole	73	802-3500	$6.6*10^{-4}$	0.17	133-343

fenitrothion

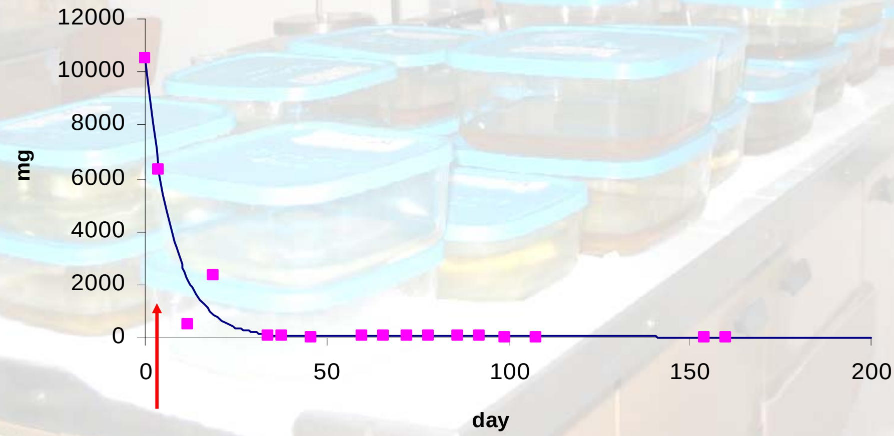
K_1 0.145

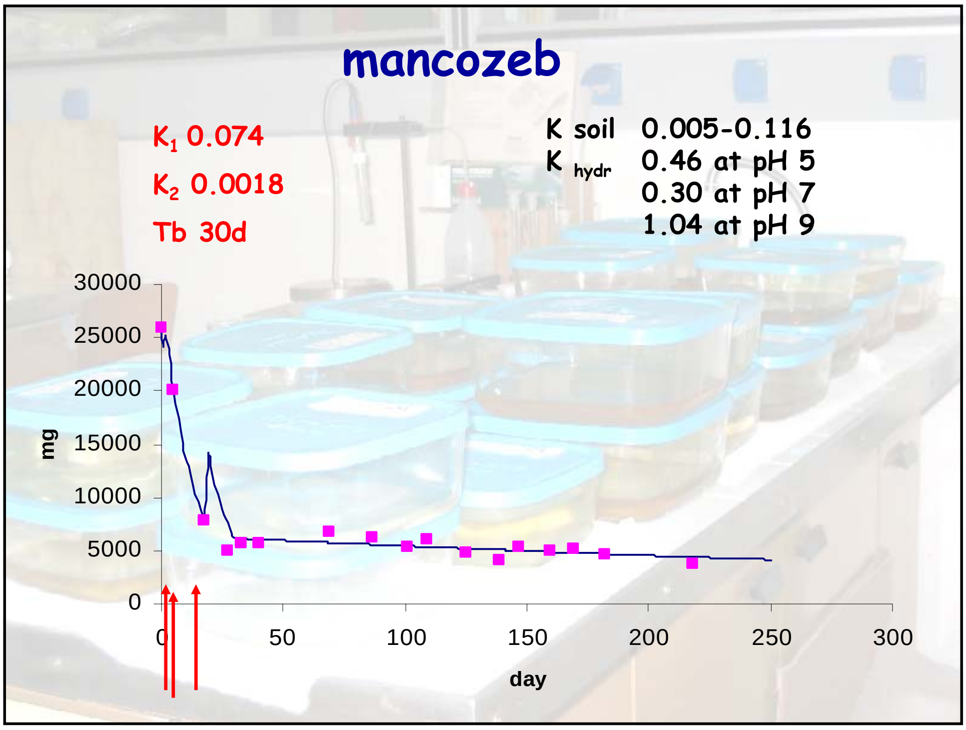
K_2 0.007

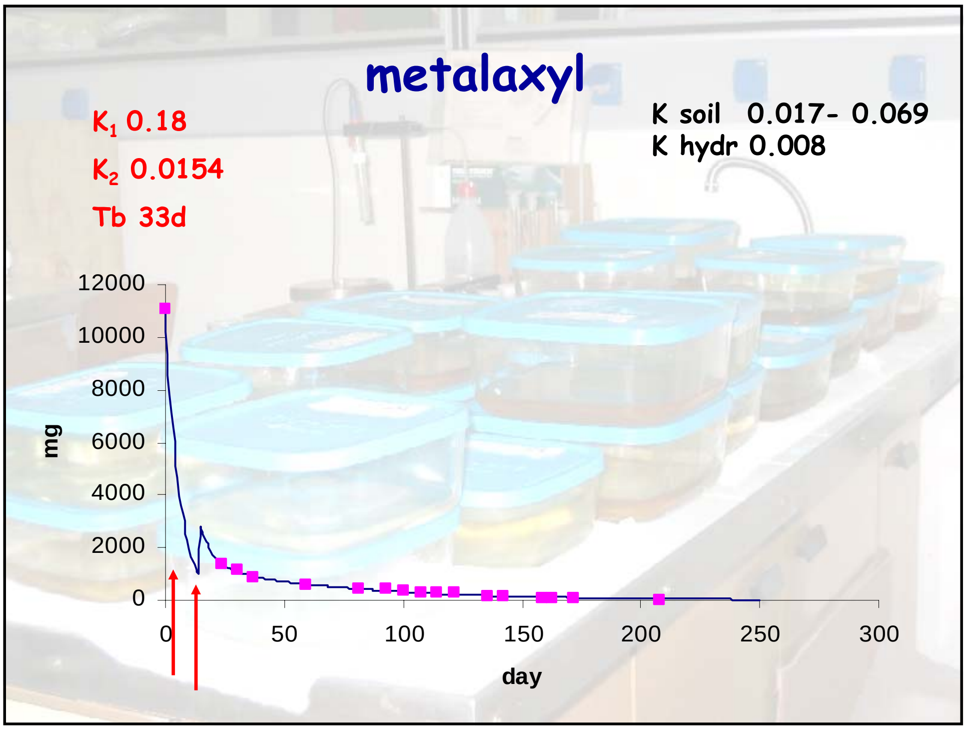
Tb 33d

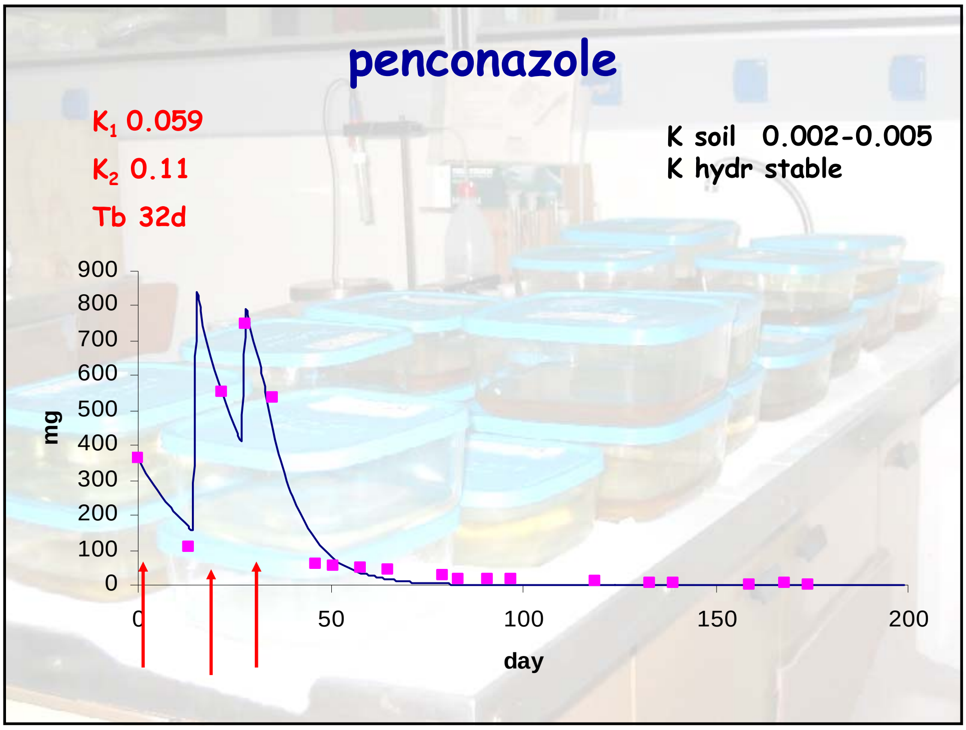
K soil 0.012-0.058

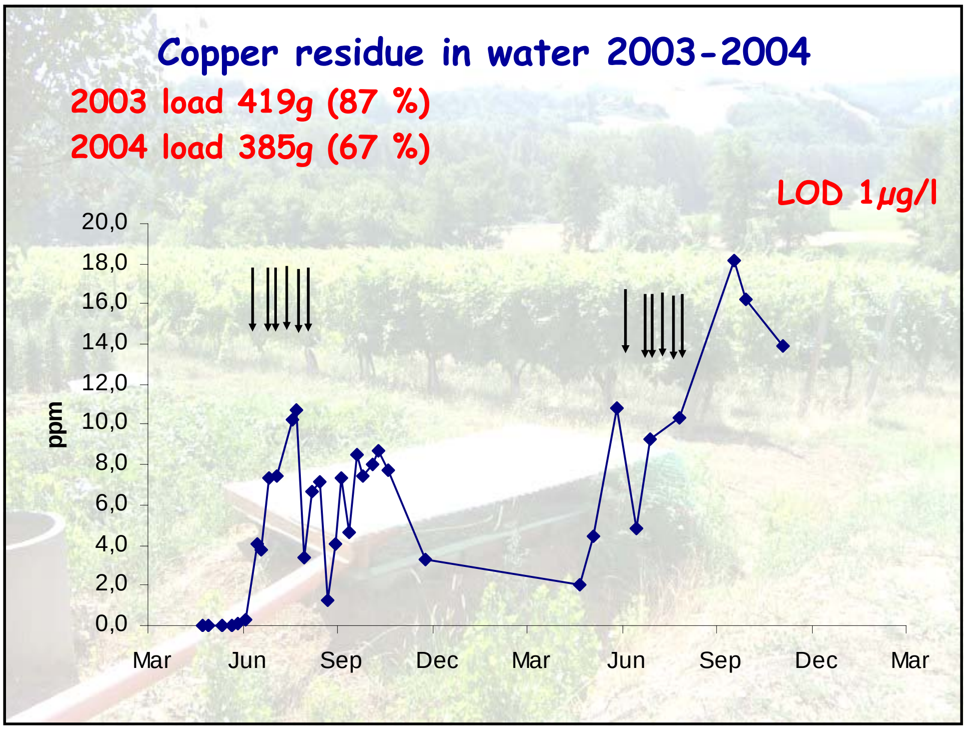
K_{hydr} 0.006 at pH 4
0.008 at pH 7
0.009 at pH 9

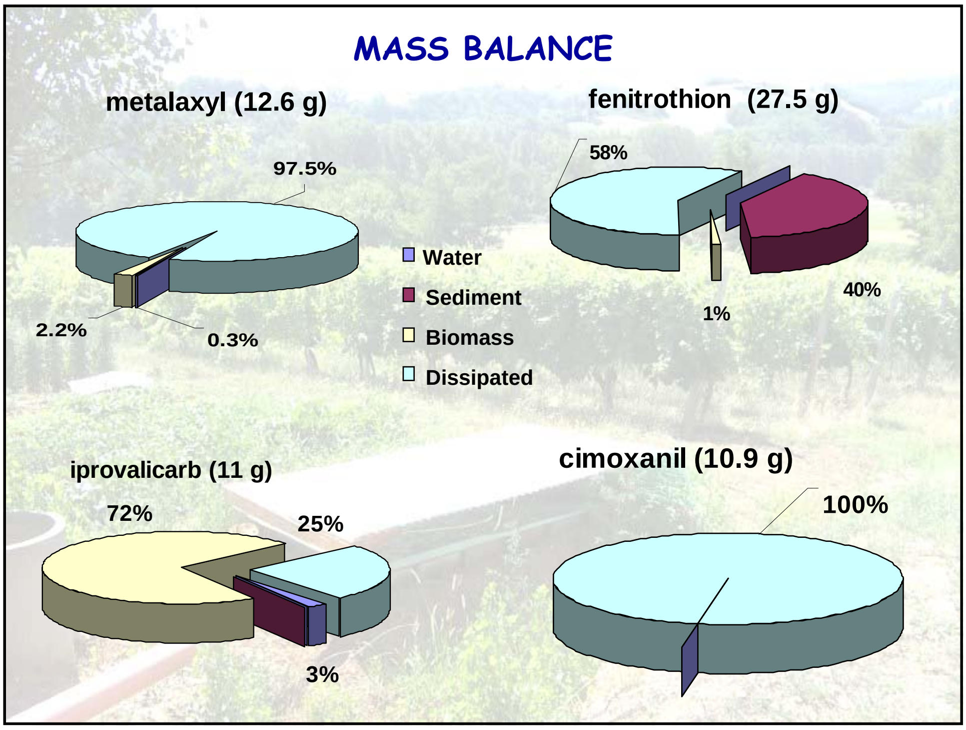


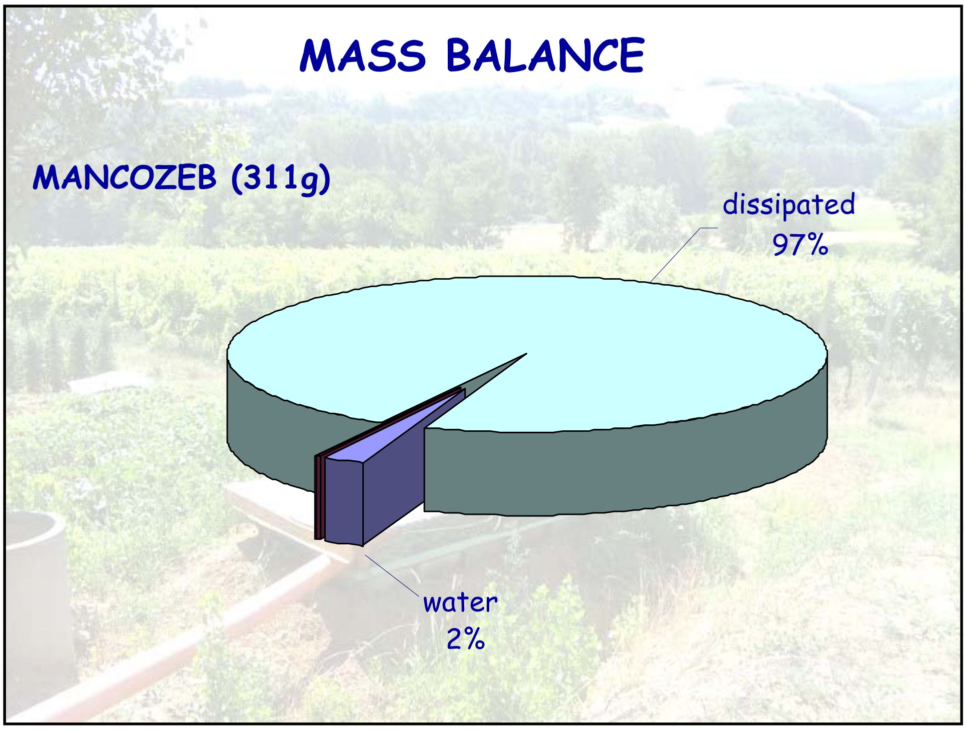

mancozeb
K_1 0.074
K_2 0.0018
Tb 30d
K soil 0.005-0.116
K hydr 0.46 at pH 5
0.30 at pH 7
1.04 at pH 9
mg
day


metalaxyl
K_1 0.18
K_2 0.0154
Tb 33d
K soil 0.017- 0.069
K hydr 0.008
mg
day

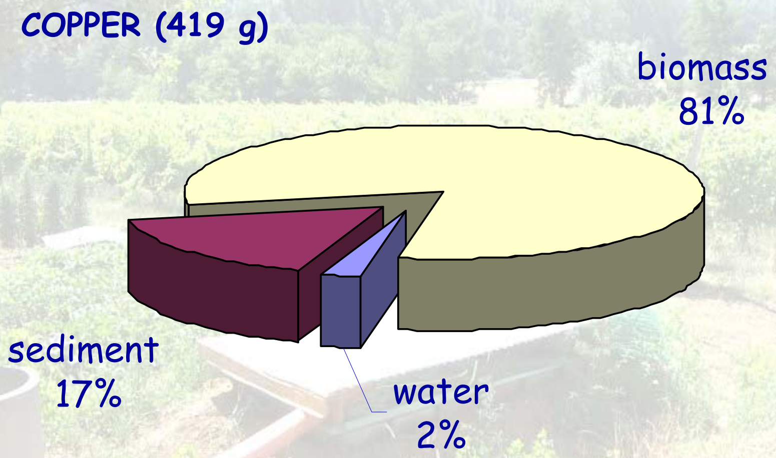

penconazole
K1 0.059
K2 0.11
Tb 32d
K soil 0.002-0.005
K hydr stable
900
800
700
600
500
400
300
200
100
0
mg
0
50
100
150
200
day


Copper residue in water 2003-2004
2003 load 419g (87 %)
2004 load 385g (67 %)
LOD 1μg/l
20,0
18,0
16,0
14,0
12,0
10,0
8,0
6,0
4,0
2,0
0,0
ppm
Mar
Jun
Sep
Dec
Mar
Jun
Sep
Dec
Mar


MASS BALANCE
metalaxyl (12.6 g)
97.5%
2.2%
0.3%
fenitrothion (27.5 g)
58%
40%
1%
Water
Sediment
Biomass
Dissipated
iprovalicarb (11 g)
72%
25%
3%
cimoxanil (10.9 g)
100%


MASS BALANCE
MANCOZEB (311g)
dissipated
97%
water
2%

MASS BALANCE



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.


Acknowledgment
The “Azienda viti-vinicola La Pusterla” (Piacenza- Italy)