A BIOBED TO RECOVER AND DETOXIFY POLLUTED EXTERNAL WASHINGS OF AG EQUIPMENT: A PROPOSAL FOR TOBACCO FARMS

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DIR. 80/778/EEC “drinking water”

- In drinking water maximum permitted concentration of agrochemicals is 0.1 µg/L for each product, with a permitted total concentration 0.5 µg/L
- This is “only” 1 gram of active ingredient in 10 million Liters water
- Agrochemicals according to this Directive are: insecticides, herbicides, and fungicides

DIR. 2008/105/EC “WATER QUALITY”

- It regards 41 “priority substances” and sets their maximum permitted concentrations in water
- Among these substances, there are 12 agrochemicals (presently 9 are still on the market in EU)

HOW THIS AFFECT AGRICULTURE ?

Dir. 2009/128/EC, Art.13 (Handling and storage of pesticides and treatment of their packaging and remnants), Point D:

D) Cleaning of the equipment used after application

Which means:

- Proper disposing of the inside rinsing of the tanks on the fields where the a.i. can be applied (LABEL)
- Proper disposing of the outside washings of the ag equipment

THE PROBLEM:
PREVENTION OF AGRICULTURE's POLLUTION

- Nonpoint source pollution from diffuse sources: e.g. related to leaching and soil erosion
- Point source pollution from a single discharge point

e.g.

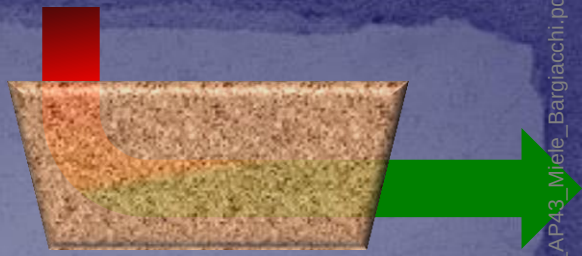
- Chemical contamination of the areas where external washings of tractors and agricultural equipment, in particular sprayers, is done
- From these areas agrochemical residues can be later washed off both to surface water (Mason et Al., 1999) and groundwater (Helweg et Al., 1994)

WASHINGS CONSIST OF SPILLS, CONTAMINATED SOIL PARTICLES, DRIED DROPLETS OF AGROCHEMICALS ADHERING TO THE EXTERNAL PARTS OF THE EQUIPMENT

PROPOSED SOLUTION: A BIOBED

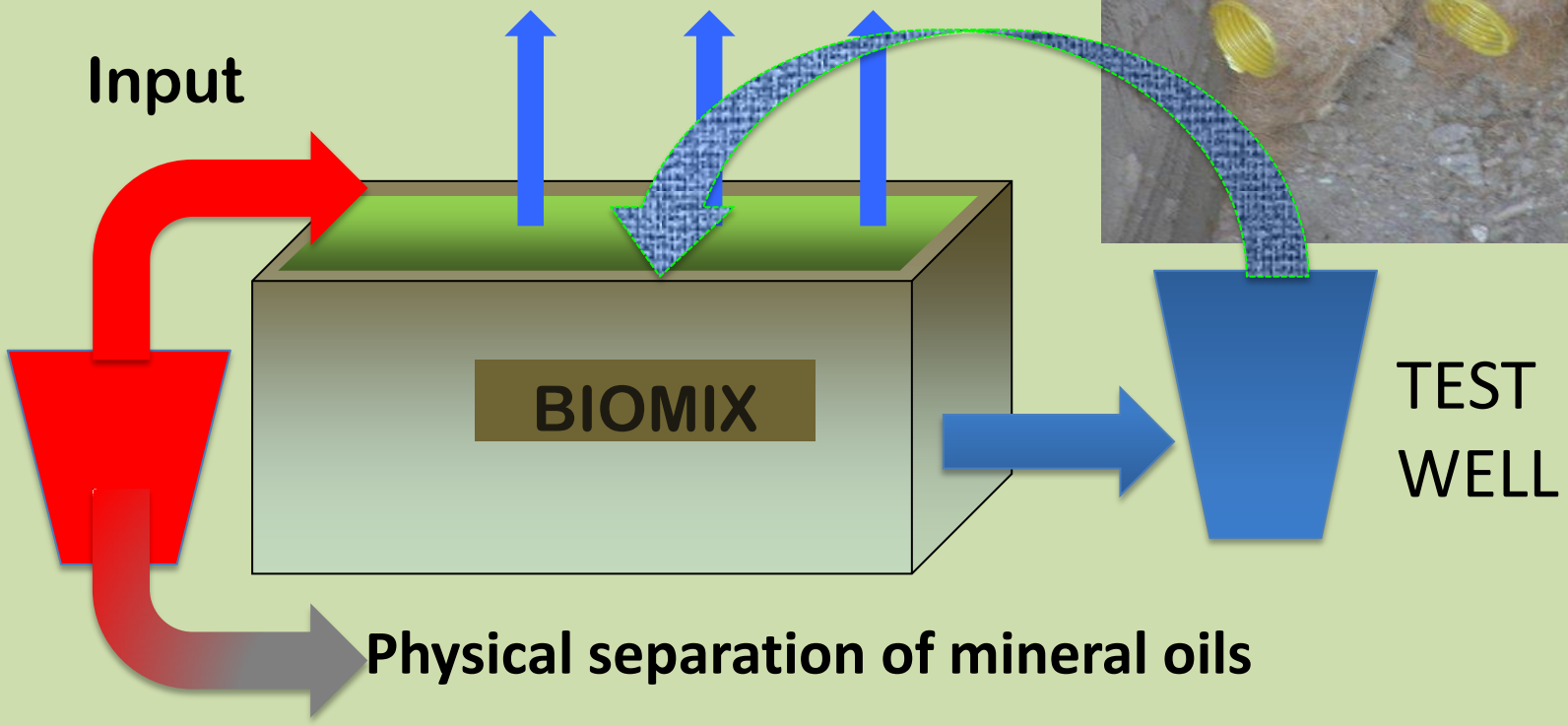
- A system to collect and convey contaminated washings to a biofilter chamber
- Simply speaking, a biobed is an impermeable handling area filled with a biomix, prepared to maximize adsorption and biodegradation of agrochemical residues from contaminated water (Fogg et Al., 2003 e 2004; Rose et Al., 2004).
- Treated products: dilute solutions of agrochemicals for crop protection and crop growth regulation
- Never dispose concentrated agrochemicals and mineral oils in a biobed (oils are previously separated)

BIOBED: THE TARGETS



- It’s a solution to the problem of agriculture’s potential point source pollution related to disposing external washings of tractors and spraying equipment
- With increasing farm size and less crop rotation, these polluted point-sources can threat more and more watersheds, because larger quantities of polluted washings are released from fewer discharge points, but repeatedly, and this increases local contaminant concentrations, with less chance for natural detoxification

BIOBED
(courtesy Castello Banfi)



Materials used as BIOMIX

Straw Manure Soil
43 – 47 – 10 (% v/v)

- or …
- Peat
- Digested phase
- Compost …

BIOMIX MATERIALS & AGROCHEMICAL ADSORPTION (Mediterranean Area)

	Straw	Tutoli	Sunflower residue	Grape Residue	Orange Residue	Olive Leaves
	K *f*(L Kg^{-1})	K *f*(L Kg^{-1})	K*f*(L Kg^{-1})	K *f*(L Kg^{-1})	K *f*(L Kg^{-1})	K *f*(L Kg^{-1})
Metribuzin	6.2	8.4	7.4	15	7.7	11
Metalaxyl	14	13	12	16	9.2	11
Terbuthylazine	36	38	47	53	140	49

E. Karanasios et al. (2010)

BIOBED: CONSTRUCTION AND MANAGEMENT

FARM

- CROPS
- INTEGRATED PEST MGNT
- AGROCHEMICALS, TYPE-DOSE
- TREATMENTS: EQUIPMENT

WEATHER

- TREATMENT FREQUENCY
- TEMPERATURE
- RAINFALL

WASHINGS

- VOLUME
- No. WASHINGS IN THE YEAR
- CONCENTRATIONS A.I.

INPUT

BIOFILTER SYSTEM

- TYPE (OPEN, CLOSE SYSTEM)
- SIZE
- BIOMIX

BIOBED: CONSTRUCTION AND MANAGEMENT

BIOFILTER SYSTEM

- TYPE (OPEN, CLOSE SYSTEM)
- SIZE
- BIOMIX

BIOMIX

- COMPONENTS
- QUANTITY
- ADSORPTION & BIODE-GRADATION EFFICIENCY

ANNUAL OUTPUT

END SERVICE OUTPUT

LEACHATES

- QUANTITY
- ANNUAL TESTS, TO CHOOSE BETWEEN:

a) REUSING

b) REFUSE DISPOSAL

BIOMIX

- QUANTITY
- TEST, TO CHOOSE BETWEEN:

a) REUSING

b) REFUSE DISPOSAL

Degradation

Abiotic: chemical and physical

Biotic : bacteria, fungi, enzymes, virus, algae, microfauna.

Single species o consortium of microbial populations

Metabolism

Co-metabolism

Polymerization or Coniugation

Accumulation

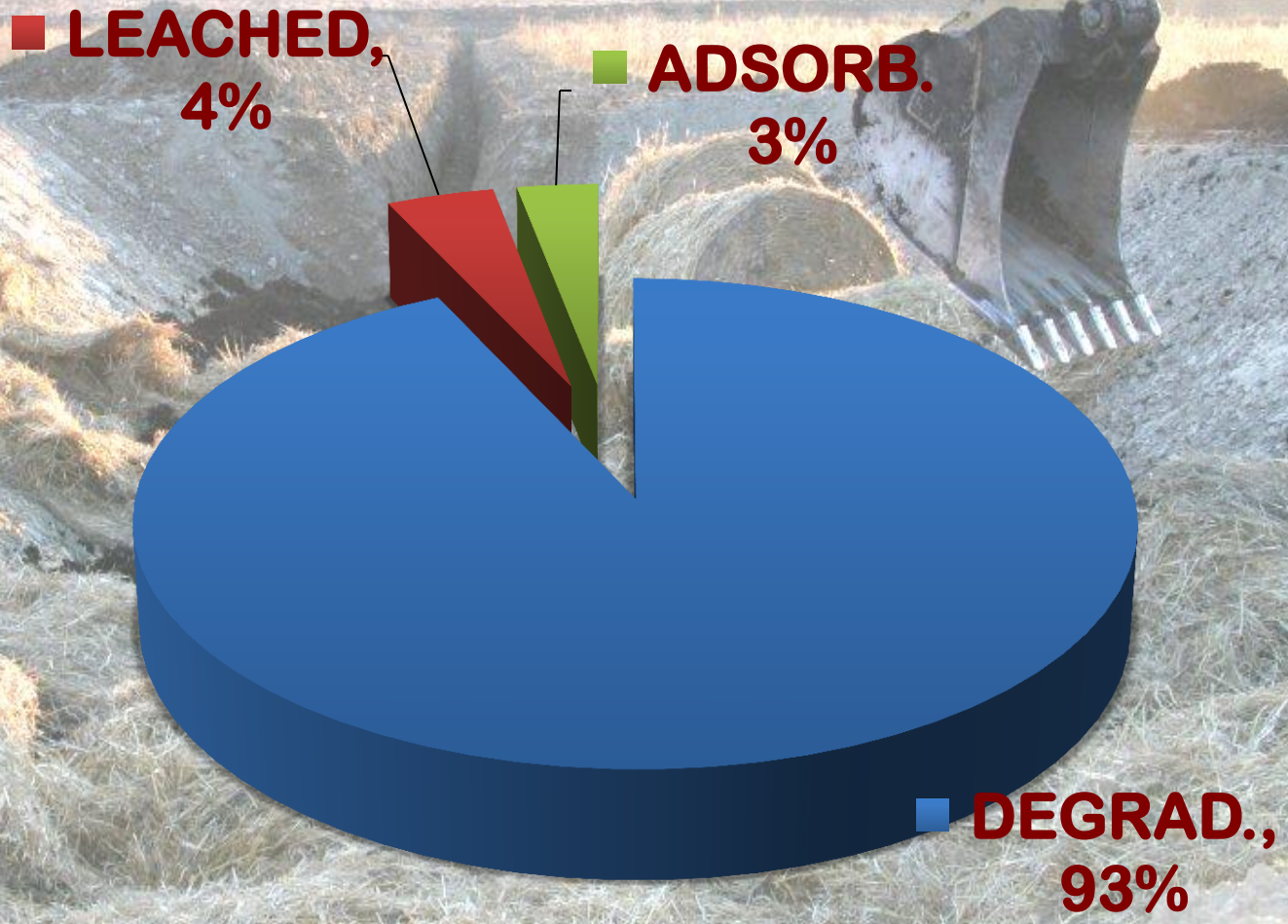
Secondary effects of microbial activity

Factors influencing agrochemical fate in the biofilter system (biobed)

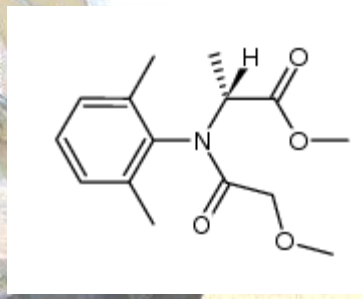
- a.i. concentration in the washings
- a.i. mix
- Water load/turfgrass metabolism
- Repeated use of the same a.i. and formulations

Agrochemical fate after biobed treatment

Literature mean data collected in different operating conditions ranging from optimal to sub-optimal



METALAXIL
2008-2011 tests
at Castello Banfi



mg/L input in biobed	mg/L output from biobed
1.5	n d.*

* Detection Limit 0.01mg/l

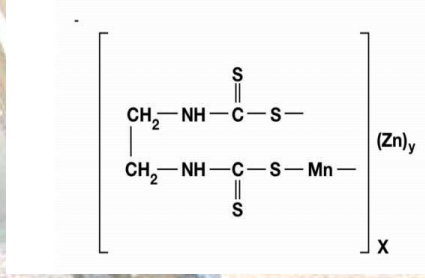
RESULTS (*)

>99.99
Degradeted/Dissipated

<0.01 Adsorbed/Removed by grass thatch

(*) MULTIRESIDUAL TESTS OF BIOBED MIX CORES AT INCREASING DEPTHS & CLIPPED GRASS SAMPLES

MANCOZEB
2008-2011 tests
at Castello Banfi



mg/L input in biobed	mg/L output from biobed
1.0	n d.*

* Detection Limit 0.01mg/l

RESULTS (*)

>99.99
Degradeted/Dissipated

<0.01 Adsorbed/Removed by grass thatch

(*) MULTIRESIDUAL TESTS OF BIOBED MIX CORES AT INCREASING DEPTHS & CLIPPED GRASS SAMPLES

AGROCHEMICAL LOADING IN BANFI's BIOBED

CALCULATED ON THE BASIS OF Kg of a.i. applied per year and related % discharged in the biobed

	2008	2009	2010	2011
Metalaxyl	9.0 (0.4 %)	10.3 (0.4 %)	13.4 (0.3%)	9.9 (0.6%)
Mancozeb	143.7 (0.6 %)	93.2 (0.5 %)	134.5 (0.4 %)	102.4 (0.8 %)

CONCLUSIONS

- Biobed is a sustainable tool to avoid agrochemical residues dispersion in the environment from external washings of agricultural equipment
- Its use is suggested with increasing hectares cropped with the same crop, and large farms or cooperatives: HIGHLY RECOMMENDED IN TOBACCO FARMS
- Output collected in the test well is reused as sprinkler irrigation of a turfgrass thatch grown on its surface
- Yearly testing of this exit leachates permits to evaluate how the biobed actually works, and decide if any corrective measure shall be programmed

Acknowledgement: Castello Banfi, Montalcino (Italy)

Where a BIOBED has been working successfully since 2008, to protect THIS ENVIRONMENT

THANK YOU

QUESTION?