5th European Biobed Workshop

27-29 September 2016

Throws Farm
Great Dunmow, near Chelmsford
Essex, UK

love every drop anglianwater

ESSEX&SUFFOLK WATER living water

SEVERN TRENT WATER

biobox System The natural solution

Wroot Water limited

anthony@wrootwater.com

5th European Biobed Workshop Programme

	Tuesday 27th September 2016
18.00-19.45	Registration and welcome dinner at Agrii, Throws Farm, Great Dunmow, Essex, CM6 3AQ

	Wednesday 28th September 2016
08.45	Registration at Throws Farm.
09.00	Welcome. The Biobed Workshop and Biobeds in the World. *Bill Basford*
	Session 1. Biobed development
09.20	Degradation of Chlorpyrifos and Endosulfan in a Swedish Type Biobed in Uruguay. *María Pía Cerdeiras*
09.40	Effectiveness of Biobed bioremediation systems made of vermicompost from olive-oil wastes to remove emergent contaminants from wastewaters. *Esperanza Romero Taboada*
10.00	Anaerobic biobed: a part of mitigation system on pesticide risk for freshwaters. *Dieter Felgentreu*
10.15	Refreshment and exhibitions
	Session 2. Applications and Monitoring
11.00	Bio-filter to protect groundwater from seed treatment washings in a potato cropping area in Norway. *Ole Martin Eklo*
11.20	Integrated biodepuration of pesticide-contaminated wastewaters from the fruit-packaging industry: Bioaugmentation, risk assessment and optimized management. *Dimitrios Karpouzas*
11.40	Monitoring the effectiveness of pesticide removal and farmer engagement potential of three on-farm demonstration biobeds and one biofilter in the arable catchments of Essex and Suffolk, UK. *Teresa Meadows*
12.00	Five years observation of Phytobac work efficiency at Institute of Plant Protection. *Tomasz Stobiecki*
12.45	Lunch at Throws Farm
	Session 3. Biobeds from a commercial perspective
13.45	Catchment Management and Biobeds at Severn Trent Water. *Katherine Filby*
14.00	Where & Why Biobeds are required in a Practical situation. *Anthony Hopkins*
14.15	UK Voluntary Initiative and biobeds/biofilters. *Patrick Goldsworthy*
14.30	Biobeds /biofilters, place in the UK, catchment significance, grants etc. *Nigel Simpson*
14.45	BioFilter: the past present and future. *Dan Fentiman, D & H group*
15.00	Biobeds in Italy: state of the art and next steps. *Camilo Gianinazzi*
15.15	Refreshment and exhibitions

Wednesday 28th September 2016 (cont.)	
	***Session 4. Adoption of biopurification systems*.**
15.30	Bottleneck in the adoption of bio-purification systems in Italy. *Maura Calliera*
15.50	Biobeds in Latin America. *Leticia Pizzul*
16.10	Current UK Biobed/biofilter practice, adoption levels, regulatory controls and challenges. Future alternatives. *Bill Basford*
16.30	Open session – Discussion and conclusions
19.00	Workshop Dinner
21.15	Return to hotels

Thursday 29th September 2016	
	Study visit (biobed, phytobac/biofilter)
08.15	Coach departs Saracen's Head Hotel
08.30	Coach departs Throw's Farm
9.30	Bayer CropScience, Great Chishill, Orchard Farm, Heydon Road, Great Chishill, Royston, Herts SG8 8SR
11.00	Russell Smith Farms, College Farm, Grange Road, Duxford, Cambs, CB22 4QF
12.00	Lunch
13.50	James Nott, Ovington Hall, Ovington, Braintree, CO10 8LD
16.00	Arrival to Stansted Airport and return to Throws Farm

Abstracts

Degradation of chlorpyrifos and endosulfan in a Swedish type biobed in Uruguay

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The white wood rotting fungi have shown a great ability to degrade xenobiotic compounds. These properties are determined by the battery of extracellular enzymes that can convert these compounds to CO_2 and H_2O. Biobeds foster the growth of microorganisms that can metabolize the pesticides spilled after preparing the final mix, washing the used containers or the application equipment.

Compounds such as endosulfan and chlorpyrifos have been considered important in Uruguay as they have been used extensively in crop protection such as soybeans, cereals and fruit trees.

We present a general strategy to build biobeds based in the biotransformation capability of a native basidiomicete and the development of validated analytical methodology to assess the remediation process along the biobed development. A screening of native basidiomycetes yielded two strains able to grow using endosulfan and chlorpyrifos as sole carbon source, degrading up to 95% in a defined medium. For the building of the biobeds, cereal bran instead of straw were chosen as they are able to support fungal growth keeping their biotransformation ability. Finally, biobeds that can metabolize both pesticides were optimized after evaluating their transformation products, different soil compositions, the presence or not of native microbiota and the influence of aeration to ascertain the usefulness of this environmentally friendly tool.

Effectiveness of Biobed bioremediation systems made of vermicompost from olive-oil wastes to remove emergent contaminants from wastewaters

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We elaborated novel biomixtures containing soil and wastes from agroindustrial origin. Wastes were reused and upgraded to higher value and useful products by mean of vermicomposting processes and then used as humified material in order to develop biobed bioremediation systems. Two biomixtures composed of soil and vermicompost of wet olive cake mixed with olive pruning or straw as texturizing agents were assayed in order to allow the removal of emergent contaminants (Ibuprofen, Diclofenaco and Triclosan) in countries where peat, a non-renewable resource, is scarce and expansive. The sorption potential and the degradation capabilities of these biomixtures were monitored in an incubation study for 84 days. The agricultural soil alone and the classical biomixture composed of soil, peat and straw were also carried in parallel for comparative purposes.

Anaerobic biobed: a part of mitigation system on pesticide risk for freshwaters

Felgentreu, D and Krause Camilo, B.

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Diffuse pollution of surface waters via runoff and erosion, base flow seepage, tile drainage, spray drift and atmospheric deposition after volatilization, and diffuse pollution of ground waters via leaching are still a challenge for water resource management. Freshwaters and particularly small water bodies are constantly threatened by the use of pesticides and fertilizer in agriculture. The risks posed by these uses have to be mitigated and reduced according to the European Sustainable Use Directive (Directive 2009/128/EC).

Wash-off and wash-out of excessively applied artificial or natural fertilizers result in high loads of nutrients in surface waters, particularly of nitrate. This can lead to the eutrophication of freshwaters which may change natural communities, increases of algae associated toxins or oxygen depletion. Additionally, pesticides and thereof particularly herbicides can enter surface waters via point-sources such as e.g., farmyard runoff, accidental spills, and spray drift. The most effective measure to reduce diffuse pollution in surface waters is certainly the reduction of applied loads of nutrients and pesticides.

However, vegetated buffer strips can also effectively mitigate the risks associated with pesticide and fertilizer use for freshwaters in agricultural landscapes.

Other suitable tools for the decontamination of drainage water, wash water or run-off water are biobeds. If they are constructed to operate in an aerobically manner, biobeds sufficiently reduce concentrations of pesticide active ingredients. Under anaerobic conditions, biobeds support denitrification as major nitrate mitigation process. However, anaerobic conditions in biobeds are in general disadvantageous for the mitigation of the herbicide agents.

In the new mitigation system proposed here, we will combine the advantage of vegetated buffer strips with anaerobic biobeds (fig. 1. and fig. 2.). Straw as a readily available organic source, and bark mulch which contains more resistant carbon species are used as substrates in the biobeds. Bark mulch in combination with straw performs as organic material source for enhanced denitrification, supposedly due to co-metabolic decomposition.

Using an anaerobic biobed system, we will test the effectiveness of such mitigation systems in vegetated buffer strips or in drainage systems for nitrate denitrification with simultaneous pesticide dissipation.

Fig. 1. Anaerobic biobed system(each container $1m^3$)

Fig. 2. Picture from the construction site of the "biobed" (photo by Krause Camilo)

Bio-filter to protect groundwater from seed treatment washings in a potato cropping area in Norway

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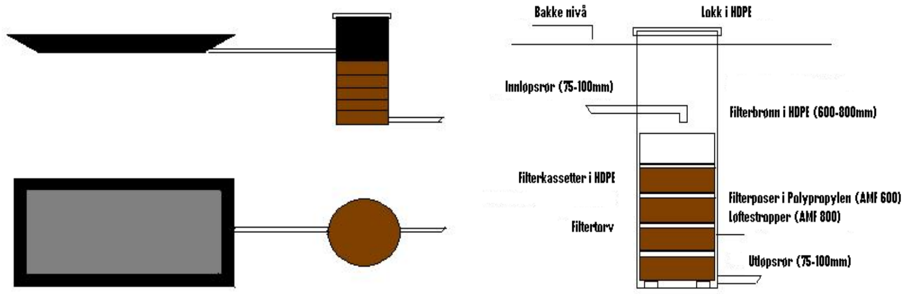
Combination of washing sites for pesticide equipment and groundwater wells require attention and good knowledge about properties of pesticides, soil and water to avoid contamination. In Norway, a previous project detected high levels of the insecticide imidacloprid in the groundwater wells. These detections could be explained by point source pollution from seed treatment of potatoes. Mitigations to protect groundwater were planned, and bio-filter was one of the measures to be introduced.

The main objective of this pilot project is to investigate a lined collection system of wastewater from seed treatment area. A geomembrane covers the treatment area and leads the waste to a well for filtration. The filtration well contains several filter cassettes, which will contain different materials.



Concept model of the collection area of wastewater with pesticide residues which lead to a well with filter cassettes (Source: Axon miljöfilter)

In previous projects, filter materials with good retention of pesticides has been tested and identified in laboratory sorption studies and column experiments. In this new pilot project, a large scale set up will be tested at farm level.

Integrated biodepuration of pesticide-contaminated wastewaters from the fruit-packaging industry: Bioaugmentation, risk assessment and optimized management

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Wastewaters from fruit-packaging plants contain high loads of toxic and persistent pesticides like ortho-phenylphenol (OPP), diphenylamine (DPA), thiabendazole (TBZ) and imazalil (IMZ) and should be treated *on site*. The need for treatment of those effluents is stressed in the relevant pesticide regulatory documents which state that *member-states should ensure that appropriate waste management practices to handle the waste solution remaining after application are put in place.* We evaluated the depuration performance of five pilot biobeds against those effluents. In addition we tested bioaugmentation with bacterial inocula able to degrade OPP, DPA or TBZ as a strategy for optimization of their depuration capacity (experimental set up Figure 1). Finally we determined the composition and functional dynamics of the microbial community via q-PCR. Practical issues were also addressed including the risk associated with the direct environmental disposal of biobed-treated effluents and decontamination methods for the spent packing material. Biobeds showed high depuration capacity (>99.5% for the recalcitrant IMZ, TBZ and >99.9% for the less persistent OPP, DPA) with bioaugmentation maximizing their depuration performance (100% dissipation) against the persistent fungicide TBZ (DT_{50soil}>1 year). This was followed by a significant increase in the abundance of bacteria, fungi and of the copy numbers of genes *catA* and *pcaH* responsible for the degradation of natural aromatic compounds. Bioaugmentation was the most potent decontamination method for spent packing material which contained residues of IMZ and TBZ. In the absence of bacterial inocula, composting was an effective alternative. Risk assessment based on practical scenarios (effluents produced by pome and citrus fruit-packaging plants) and the depuration performance of the pilot biobeds showed that discharge of the treated effluents into an 0.1-ha disposal site did not entail an environmental risk for aquatic and terrestrial ecosystems, except for TBZ-containing effluents where a risk assessment refinement was required involving either disposal to a larger disposal area (0.2 ha) or bioaugmentation (Table 1).

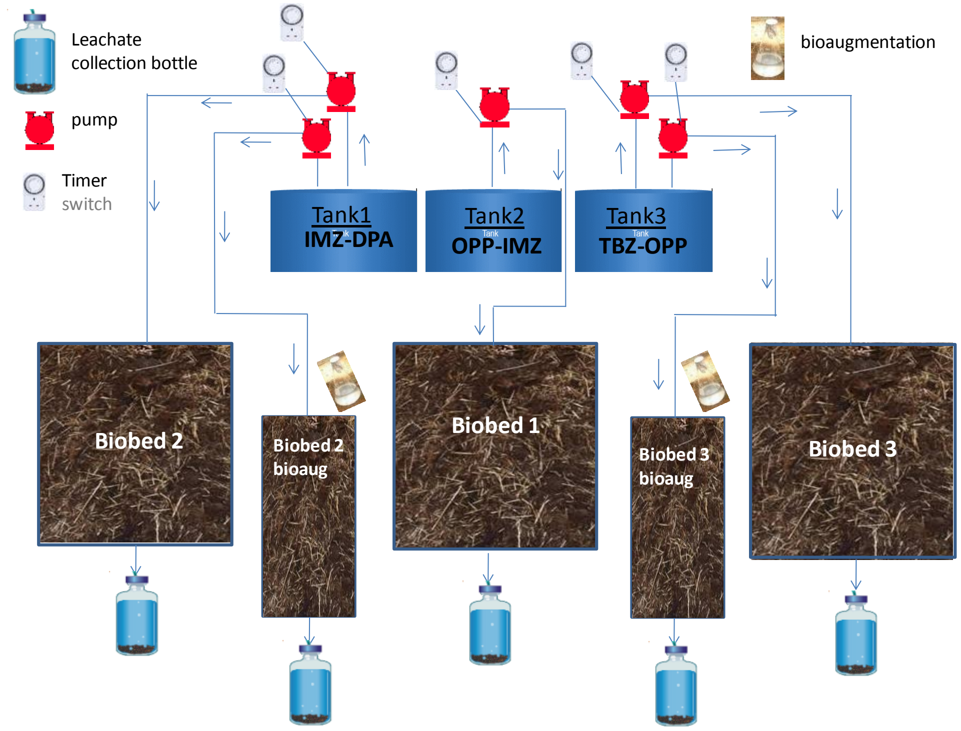

Figure 1. A schematic diagram of the setup of the pilot biobeds. Arrows indicate the direction of the wastewater flow.

Table 1. Risk assessment for biobed-treated effluents according to Scenarios I and II for aquatic organisms. Ratios of max PEC_{sw}/RAC >1 indicate unacceptable risk (in bold).

Pesticides		Acute Toxicity		Chronic Toxicity		
		Invertebrates	Fish	Algae	Fish	Sediment-Dwelling Invertebrates
		Daphnia magna	*Oncorhynchusmykiss*	*Pseudokirchneriella subcapitata*	*Oncorhynchus mykiss*	*Chironomus sp.*
*Ortho-*phenylphenol	Scenario II	0.041	0.025	0.003	0.278	0.005
Diphenylamine	Scenario I	0.053	0.029	0.021	0.009	n.d.[d]
Imazalil	Scenario I	0.138	0.244	0.108	0.502	0.119
	Scenario II	0.197	0.351	0.156	0.723	0.172
Thiabendazole	Scenario I - Step1	**1.490**	0.920	0.022	**4.217**	0.025
	Scenario I - Step2	0.576	-[a]	-	**1.633**	-
	Mitigation/Refinement	-	-	-	0.817[b] (0.366)[c]	-
	Scenario II - Step1	0.656	0.405	0.010	**1.858**	0.011
	Scenario II - Step2	-	-	-	0.717	-

[a] not calculated since no unacceptable risk was evident at Step1
[b] calculated based on disposal of biobeds effluents to a 0.2 ha disposal site (mitigation)
[c] calculated based on the depuration efficiency of the bioaugmented biobed (biobed 3bioaug) (refinement)
[d] n.d.: not determined since no toxicity endpoint values were available (see Supplementary data Table 5)

Monitoring the effectiveness of pesticide removal and farmer engagement potential of three on-farm demonstration biobeds and one biofilter in the arable catchments of Essex and Suffolk, UK

Teresa Meadows

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Pesticide contamination from farmyards can contribute a significant proportion of the pesticides found in watercourses, from which water is later abstracted and treated to supply drinking water. The installation of a bunded filling area and biobed or biofilter in the farmyard can prevent pesticide losses due to sprayer filling and washdown operations reaching the local watercourses, as pesticide washings are contained and breakdown naturally through the biomix. To examine the practicalities of construction, use and water quality benefits of this infrastructure on working farms, Essex & Suffolk Water invested in three demonstration biobeds and one biofilter in the surface water catchments from which they abstract water: the Chelmer & Blackwater, Bure, Waveney and Stour catchments respectively.

The investment in these items had a twofold purpose:

i. to construct the biobeds and biofilter in such a way as to allow for sampling of the influent and effluent, to contribute to research on their effectiveness; and

ii. to allow for farmer engagement events to be held, in order to facilitate knowledge exchange in the catchment, and to encourage the uptake and construction of further biobeds/biofilters on farms in the catchment area.

The biobeds and biofilter enabled a significant level of knowledge transfer to farmers within the catchments in which they were constructed. Events, on-farm visits, the use of the print media and a popular YouTube video allowed many catchment farmers to look at the design, construction and practical use of these items. As a result over 50 installations have been completed by farmers within the catchments, typically with grant funding assistance from Catchment Sensitive Farming.

The results of the water quality analysis show that the biobeds and biofilter are highly effective in removing a range of different pesticides, with an average of a 92.9% removal rate across all sites for bentazone, fluroxypyr, MCPA, propyzamide, triclopyr, carbetamide, chlortoluron and isoproturon. Furthermore, analysis at Tinsley Farm showed a 99.97% removal rate of metaldehyde through the biobed. However, clopyralid removal was less effective, with an average removal of 51.78% across the three sites, likely to be due to the nature of this pesticide.

The research conducted through this investigation did not show a demonstrable difference in effectiveness between the biobeds and biofilter and no statistical reduction in effectiveness was seen over the time period of data collection. Further research could look at a comparison of the effectiveness of the two systems over a longer time period and the effect of cooler winter temperatures on effectiveness of pesticide removal.

Analysis of the trends in the data has led to the development of best practice recommendations for farmers when using a bunded sprayer filling area, linked to a biobed or biofilter, which include:

- Wash the sprayer and associated equipment in the field wherever possible, away from watercourses and land drains.

- Keep the concrete sprayer filling area pad as clean from mud as possible.

- Avoid overloading the biobed or biofilter with large volumes of water at any one time. Where this is necessary, aim to regulate the flow to allow small volumes at a time, for example include a timer linked to the pump in the influent tank.

- Manage the levels of influent to the biofilter during particularly cold temperatures to ensure effective removal through the biomix.

Five years observation of phytobac work efficiency at Institute of Plant Protection

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Filling of a sprayer and washing it down are processes posing potential risk for the environment from the use of pesticides, both being a source of the so called point-source pollution. Practically all farms encounter this problem, including our own at IOR-PIB, Sosnicowice Branch, where we conduct our field research on pesticides efficacy. The need to implement consistent and safe practices for filling and rinsing of sprayers not only stems from the Directive 2009/128/EC of the European Parliament and of the Council for the sustainable use of pesticides but also from our own domestic regulations.

Worldwide, there are a number ways to reduce the risk, which evolved from the basic design of Swedish BIOBED. The system relies on the use of bioremediation processes to treat pesticide-contaminated effluents. Based on an analysis of recognized technologies, IOR-BIP Sosnicowice Branch decided to implement the solution preferred by Bayer called Phytobac. The solution combines operations done at two areas: a roofed intercept station for washing sprayers with a leak proof slab and a roofed effluent neutralizer in the form of a sealed underground basin filled with biobed mixture. The facility constructed in 2012 is used during the ongoing field work at the Branch farm, and also as an experimental unit to conduct research in real working conditions. A lot of valuable information was obtained during construction of the investment project regrading formal requirements for such an atypical facility, which could be useful for any potential parties participating in a similar investment.

The installation at Institute of Plant Protection is equipped with a valve allowing taking samples of water circulating through the system. Samples are taken twice a month and they are tested at the Laboratory of Pesticide Residue Testing of the Institute in Sosnicowice. The samples are analyzed for the presence of near 90 different active ingredients found in pesticides. From 2015 samples of soil (from neutralizer unit) are also taken and tested.

The aim of the work is in addition to providing environmental effect, check the efficiency of the pesticides decomposition. The results indicate that the concentrations present in water after washing the sprayer range from a few to over a dozen µg/l for an individual ingredient. Over time, we found that there is a significant decrease in the substance concentration levels and the effectiveness of the installation does not deteriorate.
The results of analyses carried out over the years for a number of selected substances will be presented in the presentation.

Catchment Management and Biobeds at Severn Trent Water

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I will provide a bit of background on where and why Severn Trent, alike to other water companies are choosing to work with farmers. I will give a summary of where we are working and the services we are offering - this includes part funding biobeds and biofilters. I will then provide details of the biobeds and biofilters we have funded and hopefully some results on the effectiveness of a biobed in one of our catchments.

Where & Why Biobeds are required in a Practical situation

Anthony Hopkins

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A manufacturer's perspective of biobed biobed / biofilter development. Wroot Water offer a range of products in support of the UK Irrigation industry, these have allowed development of a range of products, initially flat pack but now full and partial solutions for biobeds and biofilters.

The commercial provision of these product ranges alongside farmer and site variations are highlighted.

UK Voluntary Initiative (VI) and biobeds/biofilters

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The VI is an industry-led programme that promotes responsible pesticide use.

Key elements of the VI are the National Register of Sprayer Operators (NRoSO), the National Sprayer Testing Scheme (NSTS) and the Integrated Pest Management Plan (IPMP) replacing the Crop Protection Management Plan (CPMP).

In addition the VI provides, through its website, http://www.voluntaryinitiative.org.uk, a valuable resource of a wide range of information aiming to promote responsible crop protection actions. This includes all actions affecting sprayer filling, use and the place of biobeds and biofilters in supporting responsible and efficient pesticide use.

Biobeds /biofilters, place in the UK, catchment significance, grants

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The Catchment Sensitive Farming scheme is described in outline. This prioritises river catchments using a number of criteria for maintaining good water 'quality'.

The Countryside Stewardship Scheme is described which aims to deal with issues affecting water by offering grants assisting farmers and growers. The uptake, requirements and grants available through the scheme are identified particularly in relation to sprayer fill areas, biobeds and biofilters.

BioFilter: the past present and future

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As a specialist supplier of a wide range of liquid storage and pumping systems the D & H group evaluated farm requirements and have developed a range of products suited to bioremediation. The questions of how can the Biofilter become easier to install and maintain and what are current users looking for more of?, are discussed.

Biobeds in Italy: state of the art and next steps

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Biobeds diffusion, application and regulation in Italy. Current situation and future development in biological degradation.

Bottleneck in the adoption of bio-purification systems in Italy

Maura Calliera and Ettore Capri

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The pesticide point source contamination represents a major threat of biological and chemical integrity of natural water resources. Several studies conducted also at national level confirm that one of the causes of contamination is a non-sustainable water management at farm level, the management and washing of the sprayer waste material in the areas dedicated to the preparation of the mixture. The impact of this contamination is linked to sociological, agricultural and environmental characteristics of the territory. Recognition of the importance of this contamination is such that the European legislation decided to recognize the prevention of these sources as priorities for action through "good agricultural practice" in the on farm pesticide management. The "bio-purification systems" could represent a good practice and a technically viable alternative mitigation measure of point sources contamination, which enable to treat contaminated liquids from plant protection products directly in the farm. An analysis of the national legislation has been started in order to understand how this systems are addressed at the national level, the problems related to their implementation. Our skills are not of juridical and legal nature, but through this analysis we would like to reflect on the limits that restrict the application of bio-purification systems, and then the application of the precautionary measures legally available for the reduction of point sources contamination, which could potentially match the incentives of rural development policy. For this purpose it has been considered:

-the Directive 2000/60/EC received into Italian law by means of Legislative Decree No 152 of 3 April 2006 focusing our attention especially on the analysis of the items: sustainability, prevention, definition of waste;

-the National Action Plan for the sustainable use of plant protection products, article 6 of Legislative Decree No 150 of 14 August 2012, implementing Directive 2009/128/EC In detail annex VI.4 - Recovery or reuse of any leftover spray solution from the sprayer at the end of application and VI.5 - Sprayer cleaning at the end of the application and

-Legislative Decree no. 124 of 22/06/2012 transposing the European Directive 2009/127/EC with specific reference to sprayers.

The conclusions of the working group are therefore summarized below.

- Where possible, in order to effectively prevent the point source pollution, good practices technically viable and controllable are preferable to those that rely on good practices that require compliance with behavioural rules. Behavioural deviations from good practice are more difficult to control and, as demonstrated in the literature, can effectively cause a risk for the operators and the environment. However, be equipped with sprayer equipment conforms to legal and minimum technical requirements is not sufficient to mitigate the risk of point source pollution. Starting with the assumption that the fractions of phytoiatric mixture to be disposed are those that cannot be avoided to be produced, all the practices leading to the reduction of the concentration of active ingredient in a controlled manner and to limit the volume are to be considered as good practices or good management techniques to prevent contamination.

- *Definition of waste.* The identified critical elements are mainly related to the definition of "waste" and the level of dangerousness of the phytoiatric diluted mixture that gives rise to several contradictions. The Article 183 (LgD 152/2006) defines:

a) waste: any substance or object which the holder discards or intends or is required to discard;

b) hazardous waste: which displays one or more hazardous characteristics listed in Annex III.

As regards the "Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing" we find the codes:

02 01 08 * agrochemical waste containing dangerous substances (marked with asterisks and then classified as hazardous waste) and, 02 01 09 agrochemical waste other than those mentioned in 02 01 08.

For the national legislation diluted phytoiatric mixtures that are not redistributed and reused are defined as hazardous waste because the dilution is carried out "a posteriori" as it is the residual phytoiatric mixture to be considered as a substance or object which the holder discards or intends or is required to discard. Indeed, according to Article 184 paragraph 5-ter the reclassification of hazardous waste to non-hazardous waste cannot be achieved by diluting or mixing the waste that results in lowering the initial concentrations of hazardous substances. So it is not permissible to make a dilution of hazardous waste to reclassify it as not dangerous. However the good practice either provided in the National Action Plan then in the guidelines analysed, indicate that the appropriately diluted phytoiatric mixtures could be re-distributed in the field. This could be interpreted as that "*re-use*" is permitted by low which, according to Article 183 paragraph 1.r is defined as any operation by which products or components that *are not waste* are used for the same purposes' for which they were conceived; accordingly the diluted phytoiatric mixtures are not to be considered waste.

Another critical point is given by Article 181 bis which states that do not fall within definition in Article 183, [...] the materials, substances and secondary products

a) produced by a re-use, recycling or recovery of waste;

b) of which the source, the type and characteristics of the waste from which it can produce, are identified;

c) the re-use, recycling or recovery that produce them are identified.

The definition of waste is therefore strongly linked to the subjective concept of the term "discard" and evaluation of the circumstances. It is our opinion that the definition of diluted phytoiatric mixtures and its classification in hazardous or non-hazardous waste should be questioned and better assessed.

- *Definition of prevention :* Prevention is defined as "measures taken before a substance, material or product becomes waste that reduce:
-

1) the amount of waste also through the *re-use* of products or the extension of their life cycle;

2) the adverse impacts of waste on the environment and human health;

3) the content of harmful substances in materials and products;"

Chemical or physical-chemical bio purification systems would result in a very special form of "storage" that precedes any stage of the waste management (collection, transport, disposal or recovery).

Therefore, placing diluted phytoiatric mixtures in a system intended as a technique used to prevent or reduce emissions and the impact on the environment such as the chemical or physical chemical bio purification systems should fall outside the "concept of temporary storage" but rather, should be regarded as a good technical / structural practice in compliance with the preventive phase as planned by the priority criteria hierarchy and according to the principles of sustainability. The "bio-purification systems" can be seen:

➢ as "valid recovery technique" as required by Article 5, paragraph 1, lett. l-ter of Decree 152/2006 that is techniques [...] designed to prevent and, where this is not practicable, generally to reduce emissions and the impact on the global environment,

➢ as "self-disposal systems"

➢ as the best environmental option in terms of the waste management hierarchy as described in the first articles in Part Four of Decree 152, as it fully respects the priority criteria in particular the first criterion relating to prevention.

Biobeds in Latin America

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Latin America and the Caribbean is a very extensive and varied geographic region and has a total of 740 million ha agricultural land. As a result of the intensification of the agriculture the use of pesticides in the region has increased in the last 30 years, and concomitantly the appearance of pesticides in water (Laabs et al., 2002; Echeverría-Sáenz et al., 2012; Montes et al., 2012). The biobed is a useful tool to minimize the risks of point source contamination with pesticides at the farms and they have shown to have positive effects on the quality of waters.

Because of their effectiveness, low cost and simplicity biobeds are an attractive option. An important feature is that their design is flexible and can be used almost everywhere and adapted to different type of production units, including small farmers, who represent a large group in LAC. In fact biobeds have been already successfully implemented in Guatemala since 2004 and today there are 2500 functioning units in different parts of the country. Chile is also developing an intense activity around the biobed at the level of academic research, pilot biobeds building in cooperation with various agricultural enterprises, campaigns at various levels, including schools.

In the rest of LAC there is an increasing interest in the technology, and some experiments are being carried out at laboratory and pilot scale in Uruguay, Argentina, Brazil and Mexico.

However, in the LAC countries, with the exception of Guatemala, the biobed has not been massively adopted. We have carried out a number of activities aiming to promote the technology at the regional level. These initiatives will be discussed during the presentation.

References

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Current UK Biobed/biofilter practice, adoption levels, regulatory controls and challenges. Future alternatives.

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Considerable interest continues in improving sprayer filling areas, particularly in filling sprayers in roofed areas to avoid rainfall. Regulation limits the volume of sprayer washings treatable annually through any biobed / biofilter system and the position of any equipment involved to protect surface and ground waters. Biobed and biofilter development within the UK is summarised including the scale of adoption and challenges involved in adoption will be discussed.

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