A challenge for biobed use expansion in France: to upgrade safe and efficient devices

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The French context for biobed…

A rapid history…

Since 2001…

INRA expériments in Dijon with a series of « biobacs » (Ponce thesis)

2005-2007…

In coll. with Biotisa (Start-up)

-Testing of carbon and microbial starters to increase degradation

-Development of a set of laboratory tests to assess biobed efficiency and ecotoxicological risk

Since 1997…

Adaptation by **BCSF** of the Swedish concept and first experimentations in France with the Phytobac®

2006…

Development of the Phytobac® of **Biotisa**: a whole of equipments and services for safe use in agricultural and non agricultural areas

September 2006…

French regulation has clearly established and obligation for farmers to manage effluents from rinsing and washing equipments.

Phytobac ® is currently the only biobed process agreed in France

Main specific characteristics for biobeds (Phytobac®) in France :

Technological aspects	
‣Watertight containers	***BCSF specifications for Phytobac®)***
‣Rain protection	
‣Soil and straw (30% v/v) are the main components of the substrate mixture	
‣Spreading of the residual contents of biobeds in field are allowed after treatment:	***French régulation***
Biological aspects	
‣Most soils have a low content in OM	***No specific increase in adsorption capacity***
‣No peat addition in the biomix	
‣Generally no manuring	
‣Most soils have a neutral or alcalin pH	***Bacteria including actinomycetes population could be important***
‣Herbicides are often present	

Some French Phytobacs® and monitoring…

(with the permission of Biotisa)


Phytobac® from Biotisa for
great volume of effluents)


Phytobac® from Biotisa for great volume of effluents)
Phytobac
Bayer CropScience
2007 9 7

Experimental device for small volume of effluents (Biotisa)


INRA/BIOTISA
experiments

Monitoring:

Chemical and microbial analysis were carried out for each new Phytobac® fitted out by Biotisa…

At regular intervals « biological capacities » and residual toxicity are controled and possible dysfunction were remedied …

LE CERTIFICAT DE SANTE PHYTOBAC®

1.Biomasse microbienne : **importante (393 mg C/kg)**	☺
2.Activité globale (respiration) **bonne : (2,1 mg C/j/kg sol)**	☺
3.Quotient métabolique : **5,3 10^{-3}**	☺
4.ADN ratio bactéries/champignon : **Indice favorable (1,3)**	☺
5.Activité dégradante "benzoate« : **très bonne activité**	☺
6.Activité dégradante "phytos« : **Bon indice (I=393)**	☺

☺ *0K* ● *Be careful!* ● *Stop! Remedy!*

LABORATORY TESTS FOR MICROBIAL BEHAVIOUR ASSESSMENT IN PHYTOBAC®

Biodegradation tests with labelled pesticides

Basal respiration

MICROBIAL BIOMASS (FE METHOD)

Microbial populations

ECOTOXICITY TESTS

Tests carried out after 6 months of Phytobac® use

French regulation allows the spreading of Phytobac® content 6 months after the last effluent supply in the limits of 10 m3/acre (about 1% of the whole soil)

Other laboratory and pilot experiments …

Previous results :
Carmen Ponce (thesis, 2004)

Less than 1% of a mixture of 14 herbicides (100g of a. i. in total) were extracted after 15 months from 200 litre containers filled with different biomixes

Mixture of herbicides, fongicides and insecticides didn't drastically affected the degradation (lab. tests)

Repeated applications of effluents resulted in an increasing degradation rate of certain pesticides (lab. tests)

But…

Experiments were carried out during only 3 years

Pesticide mixtures were not « realistic »

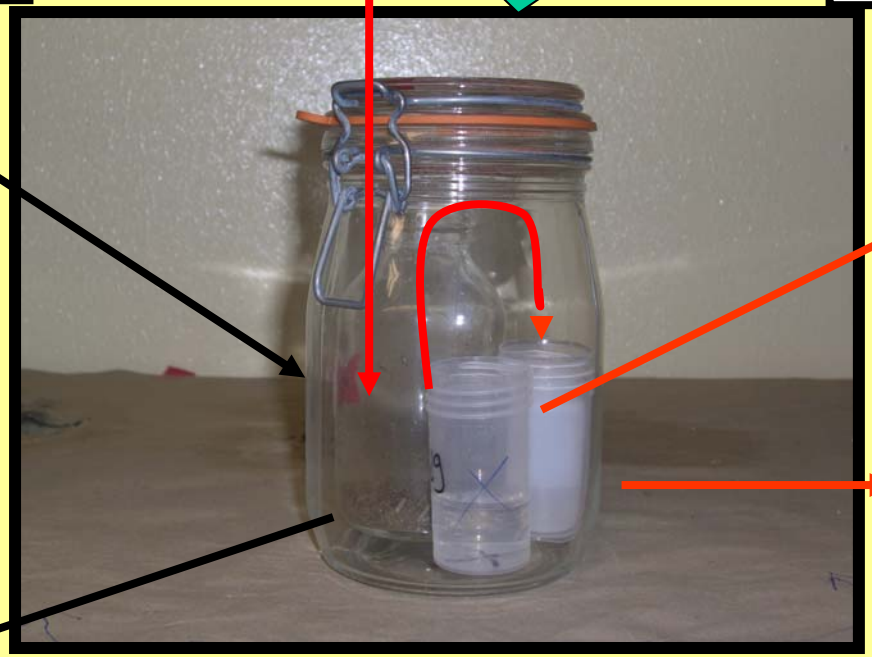
Testing of « starters » for microbial dégradation (1)

Experimental conditions

Starters:
.Carbon substrates
.adapted soil

^{14}C Pesticide

Soil samples from different biobeds



$^{14}CO_2$

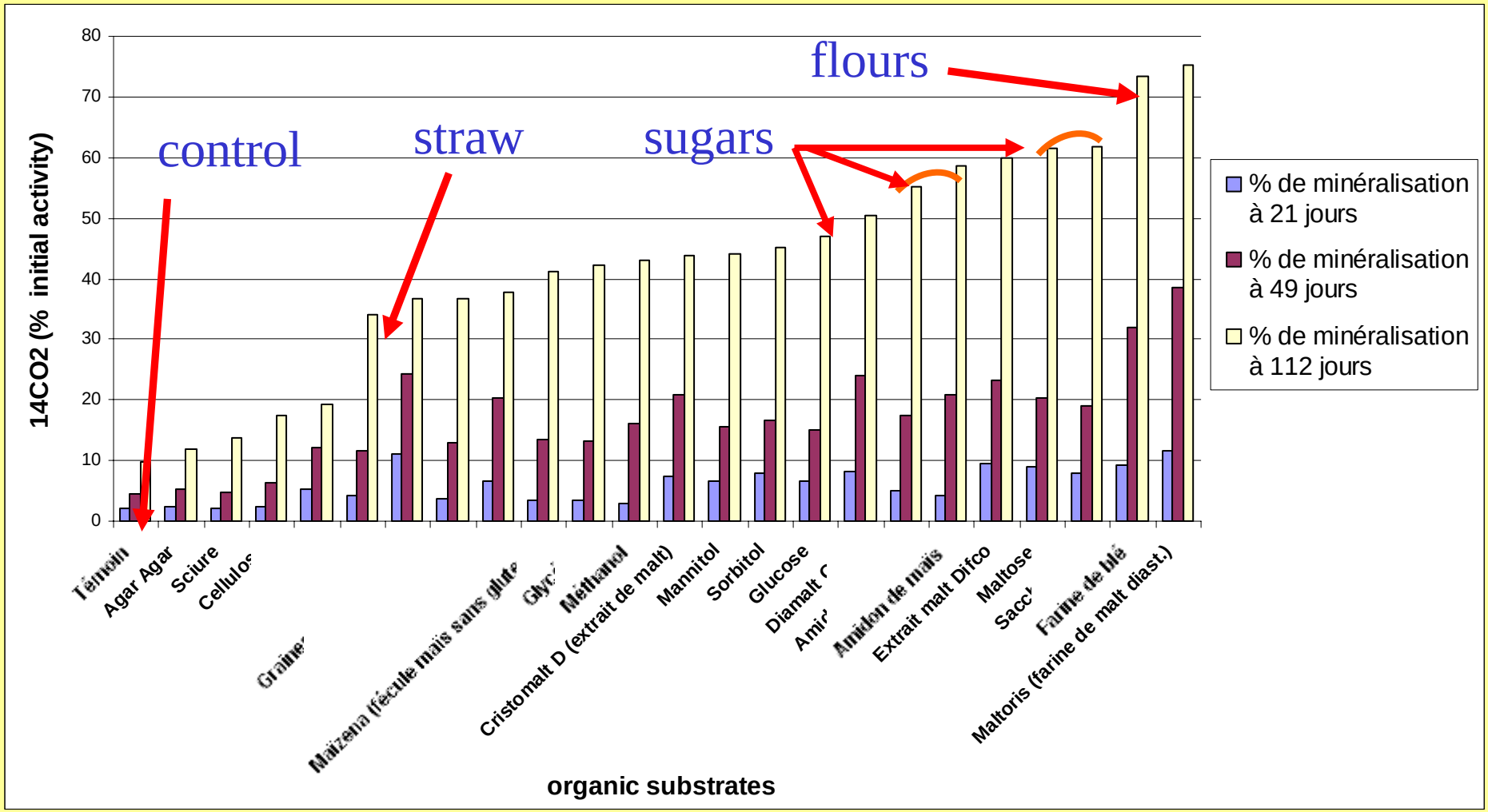
Organic Solvent or water extraction of ^{14}C residues

Métabolites

- Respiration (CO_2)
- C-Biomasse

Testing of « starters » for microbial dégradation (2)

Effect of different organic substrates (1g/kg soil) on the mineralisation of ^{14}Ccarbonyl-diuron



Testing of « starters » for microbial dégradation (3)

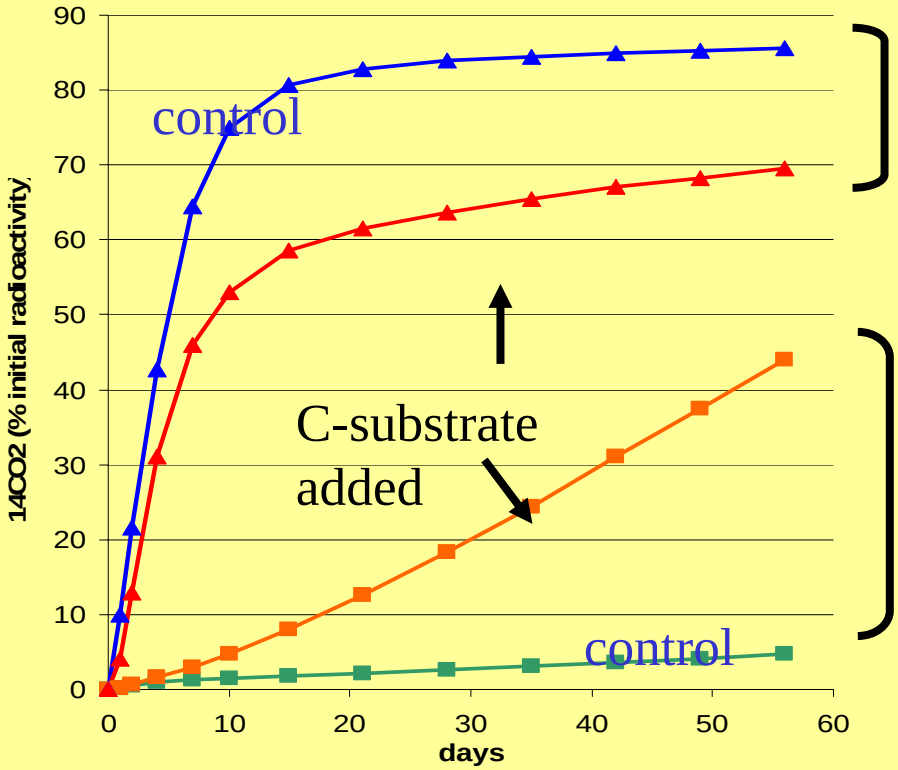
^{14}C-residues (% of the initial activity extractable from control and enriched samples)

^{14}C-Pesticide (3 mg a.i. / kg soil)	Soil origin (biobed)					
	Dijon (no effluents)		Confoux (no effluents)		Aloxe-Corton (3 years use)	
	control	*+substr*	*control*	*+substr*	*control*	*+ substr.*
Diuron	60% →	26%	47% →	10%	62% →	33%
Bentazone	33% →	16%	27% →	6%		
Isoxaben	67% →	54%				
Oryzalin	24% →	10%				
Glyphosate	33% →	16%	11% →	8%	17% →	13%

Substrate: Barley flour 1% *Incubation: 56 days*

Testing of « starters » for microbial dégradation (4)

Carbon substrates, adaptation or inoculation ?



Soil from biobed with history of pesticide use

Soil without history of pesticide use

Natural adaptation or inoculation of biobed substrates are the best ways to get a rapid mineralisation of pesticides. ***But*** *for many compounds, efficient degrading strains or communities are lacking, therefore, only stimulation of co-metabolic processes with organic carbon amendments can increase the degradation of most persistent pesticides present in the effluents.*

In conclusion :

Biobed is a very pertinent and simple concept based… on very complex mechanisms

« Self made », poorly documented installations may result in unsatisfying results and sometimes to an environmental risk

To prevent errors in device conception, remediate equipment failure, and maintain for years an optimal efficiency of the system, it is necessary to respect a minimum of rules concerning the installation and the control of device running

Monitoring of biobeds, especially requires alternative methods to the chemical analysis…But methods prescribed should present both, a large ecological and agronomical significance and a very low cost acceptable by farmers

Long term studies have also to be carried out in different and representative sites in agricultural or horticultural areas. These studies should allow to prevent and to remedy disfunctions of the biological system

..,

Laboratory studies should be also pertinent. Firstly, biobeds represent pertinent models for the study of microbial diversity and adaptation mechanisms in chemically stressed environments. Secondly, in the limits of current regulation in each European country, what biotechnological tools could be proposed to control or to improve the efficiency of biobeds?

Finally what do we want :

A system which favours the adaptation of degrading microorganisms ?

A system which favours co-metabolic mechanisms ?

A system which favours the retention of pesticide residues ?

Do we hope a single well-definite system for all European countries whatever agricultural and pedoclimatic conditions ?

Or in contrast do we accept a diversity of concepts and designs probably more favourable for the technical evolution of the biobed process ?

Thank you !