Implementation of biobeds in Greece: Where do we stand?

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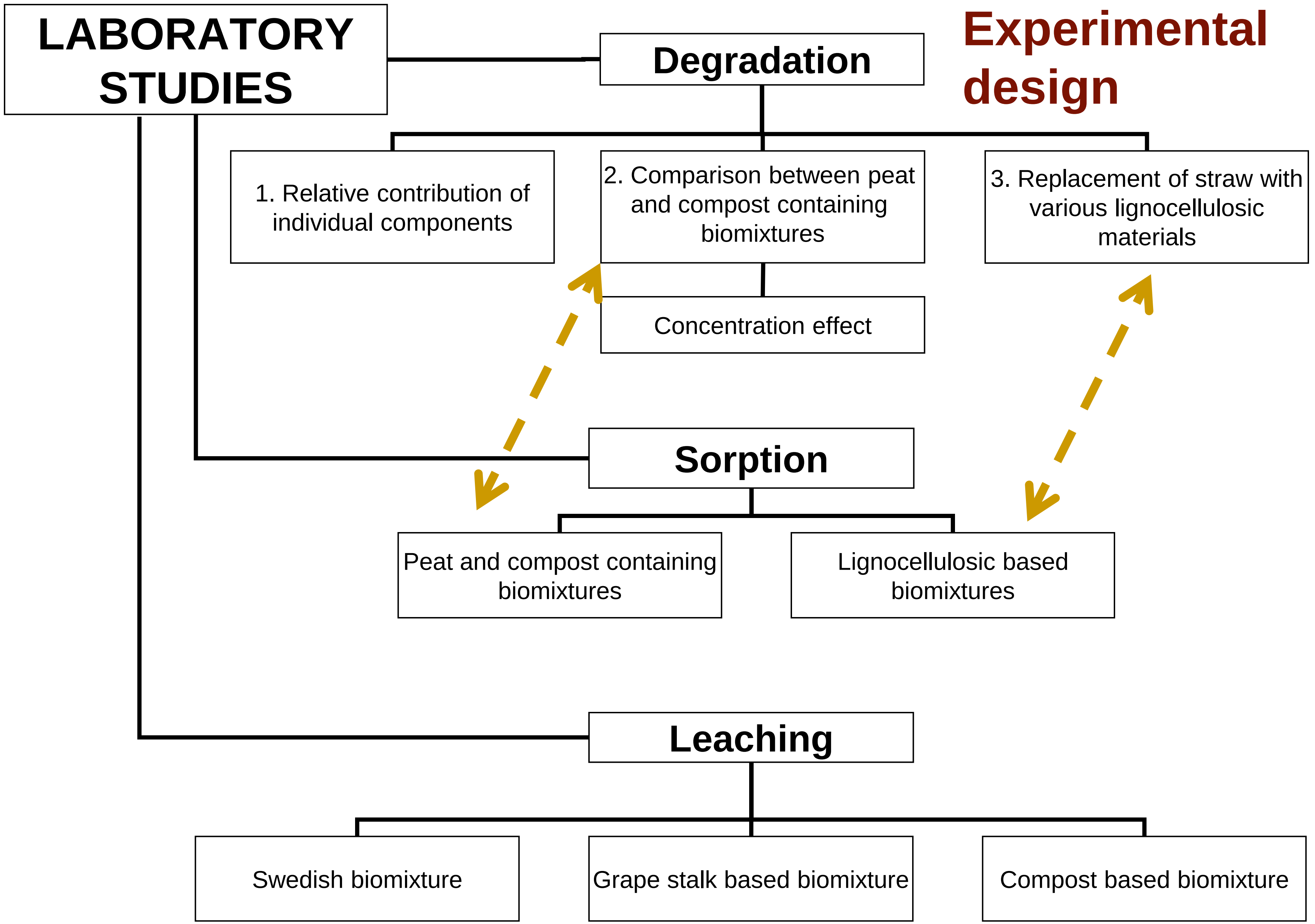
Research on biobeds in Greece

- **Laboratory studies:**
  Selection of most efficient biomixture
  - Degradation
  - Microbial Activity
  - Sorption
- **Semi-field studies:** Assess ability of biomixtures to retain pesticides
  - Column studies
- **On-Farm pilot biobed systems**: funding?

We are at phase II, a step before setting up on-farm biobeds


LABORATORY STUDIES
Degradation
Experimental design
1. Relative contribution of individual components
2. Comparison between peat and compost containing biomixtures
3. Replacement of straw with various lignocellulosic materials
Concentration effect
Sorption
Peat and compost containing biomixtures
Lignocellulosic based biomixtures
Leaching
Swedish biomixture
Grape stalk based biomixture
Compost based biomixture

Phase I

Laboratory Studies to choose the most appropriate biomixture for biobeds in Greece

- Degradation
- Microbial activity
- Sorption

Degradation studies - Contribution of biomix components on the overall degradation efficiency

Substates

- Soil+Compost* (2:1)
- Soil+Straw (1:1)
- Soil+Straw+Compost (1:2:1)
- Soil

	pH	Organic C (%)	Total N (%)
Soil (S)	6.57	1.8	0.19
Straw (Sw)	7.30	42.9	0.56
Compost (C)	6.74	25.9	2.49

Pesticides - Application rate

Dimethoate (33.3 μg g^{-1})

Terbuthylazine (72.9 μg g^{-1})

Metribuzin (43.8 μg g^{-1})

Metalaxyl-M (40 μg g^{-1})

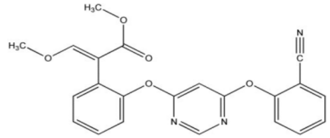
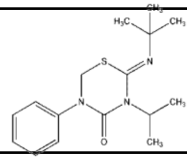
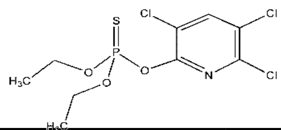
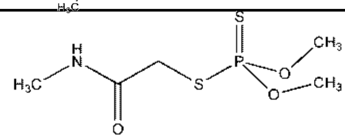
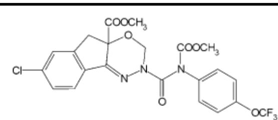
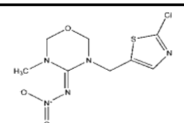
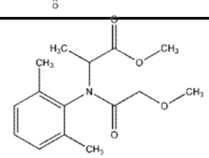
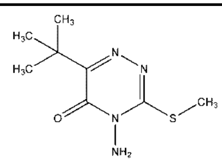
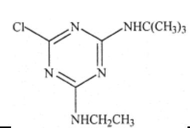
Iprodione (52.1 μg g^{-1})

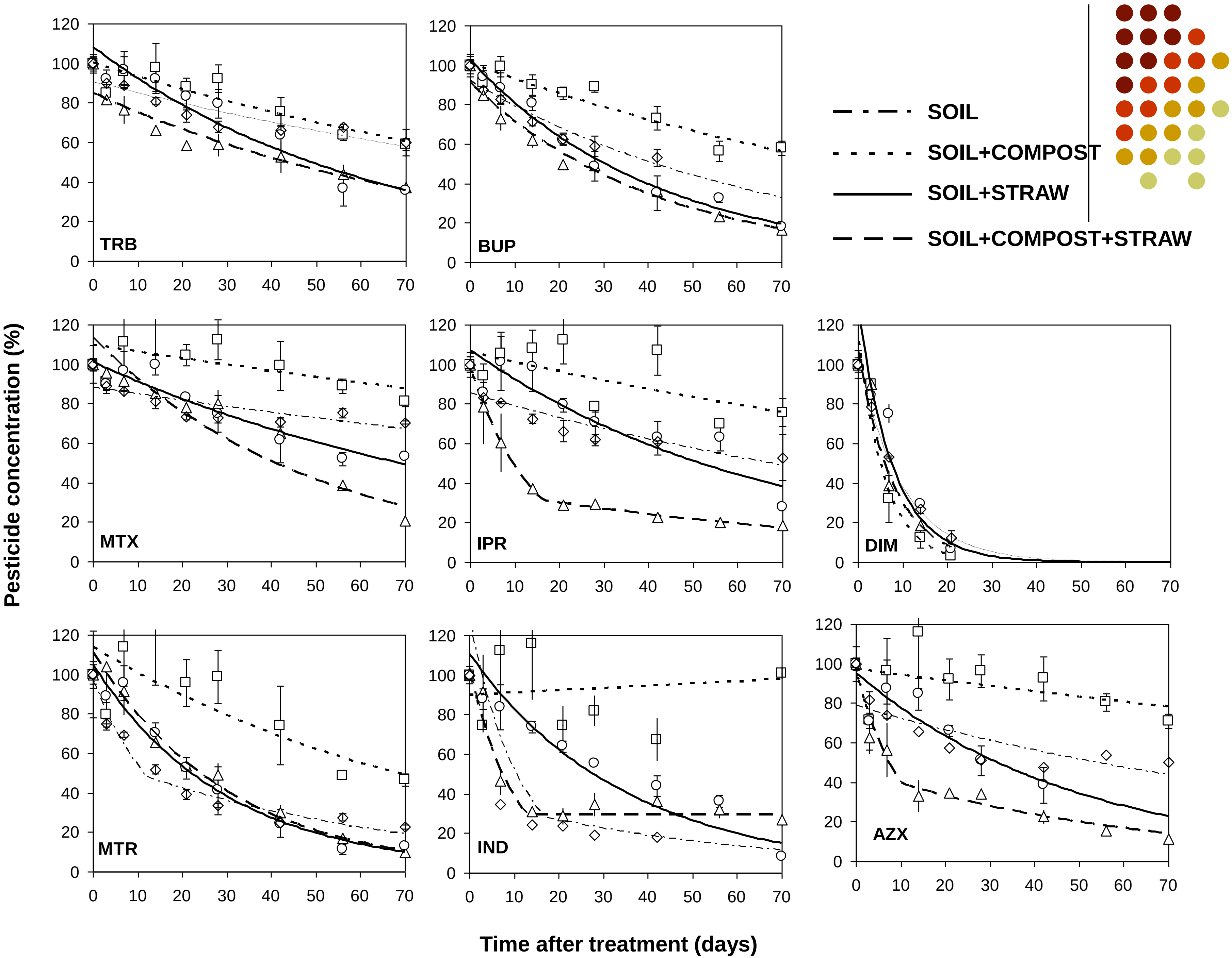
Indoxacarb (4.1 μg g^{-1})

Buprofezin (15.6 μg g^{-1})

Azoxystrobin (33.3 μg g^{-1})

*Compost *Agaricus bisporus*

Name	Structure	Solubility	$T_{0.5}$	K_{oc}	Leaching Potential index	GUS index	Toxicity class
azoxystrobin		6.7	21	423	-	2.53	-
buprofezin		0.382	56	104	-	3.37	III
chlorpyrifos		1.05	21	8151	30	0.15	II
dimethoate		23800	7.2	30	47	1.05	II
indoxacarb		0.2	20	6450	4	0.23	III
iprodione		13	84	373	33	2.75	IV
metalaxyl-M		26000	39	660	59	1.88	III
metribuzin		1165	19	38	52	2.57	III
terbuthylazine		8.5	46	220	-	2.74	III



SOIL
SOIL+COMPOST
SOIL+STRAW
SOIL+COMPOST+STRAW
TRB
BUP
MTX
IPR
DIM
MTR
IND
AZX
Pesticide concentration (%)
Time after treatment (days)

Degradation studies - Contribution of biomix components on the overall degradation efficiency

- The simultaneous presence of all three constituents (soil+straw+compost) in biomixture is a prerequisite for maximized degradation efficiency

Degradation studies – Composts instead of peat?

Substates

- Soil+Straw+ { *Agarisus bisporus* substrate compost (BX1), Olive leave compost (BX2), Sea wrack compost (BX3), Cotton residues compost (BX4), Cotton seed compost (BX5) } (1:2:1)

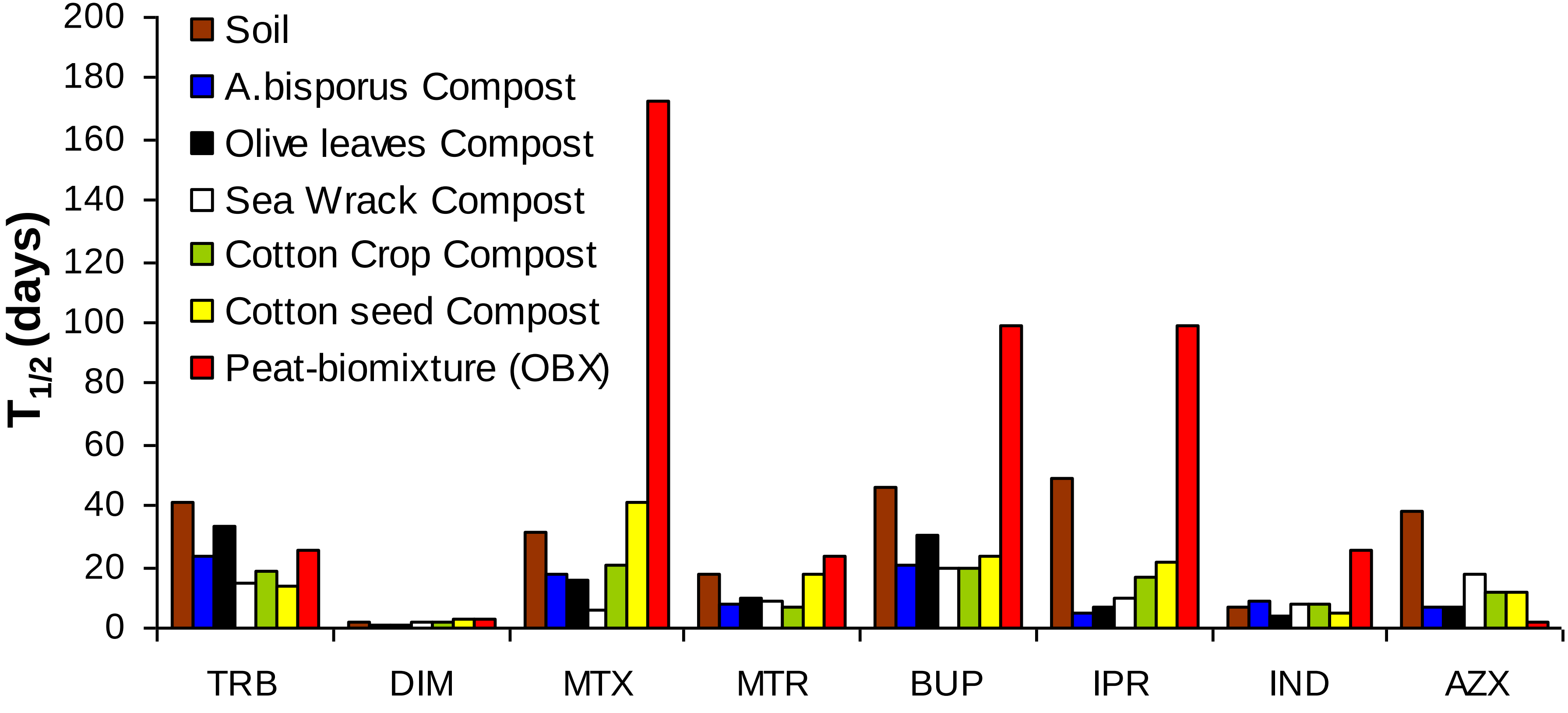
  Agarisus bisporus substrate compost (BX1)
  Olive leave compost (BX2)
  Sea wrack compost (BX3)
  Cotton residues compost (BX4)
  Cotton seed compost (BX5)

- Soil+Straw+Peat (1:2:1) OBX
- Soil

Pesticides

terbuthylazine (TRB), metribuzin (MTR), metalaxyl (MTX), iprodione (IPR), indoxacarb (IND), azoxystrobin (AZX), buprofezin (BUP), dimethoate (DIM)

Degradation studies – Composts instead of peat?



Karanasios et al., (2010) J. Agric. Food Chem. (in press)

Degradation studies – Composts instead of peat?

- Compost-containing biomixtures can degrade more efficiently the pesticide mixture than the original biomixture
- Overall, the biomixture containing olive leaves compost (BX2) appear to be the most efficient in the degradation of most pesticides tested

Degradation studies – Other lignocellulosic materials instead of straw?

Substates

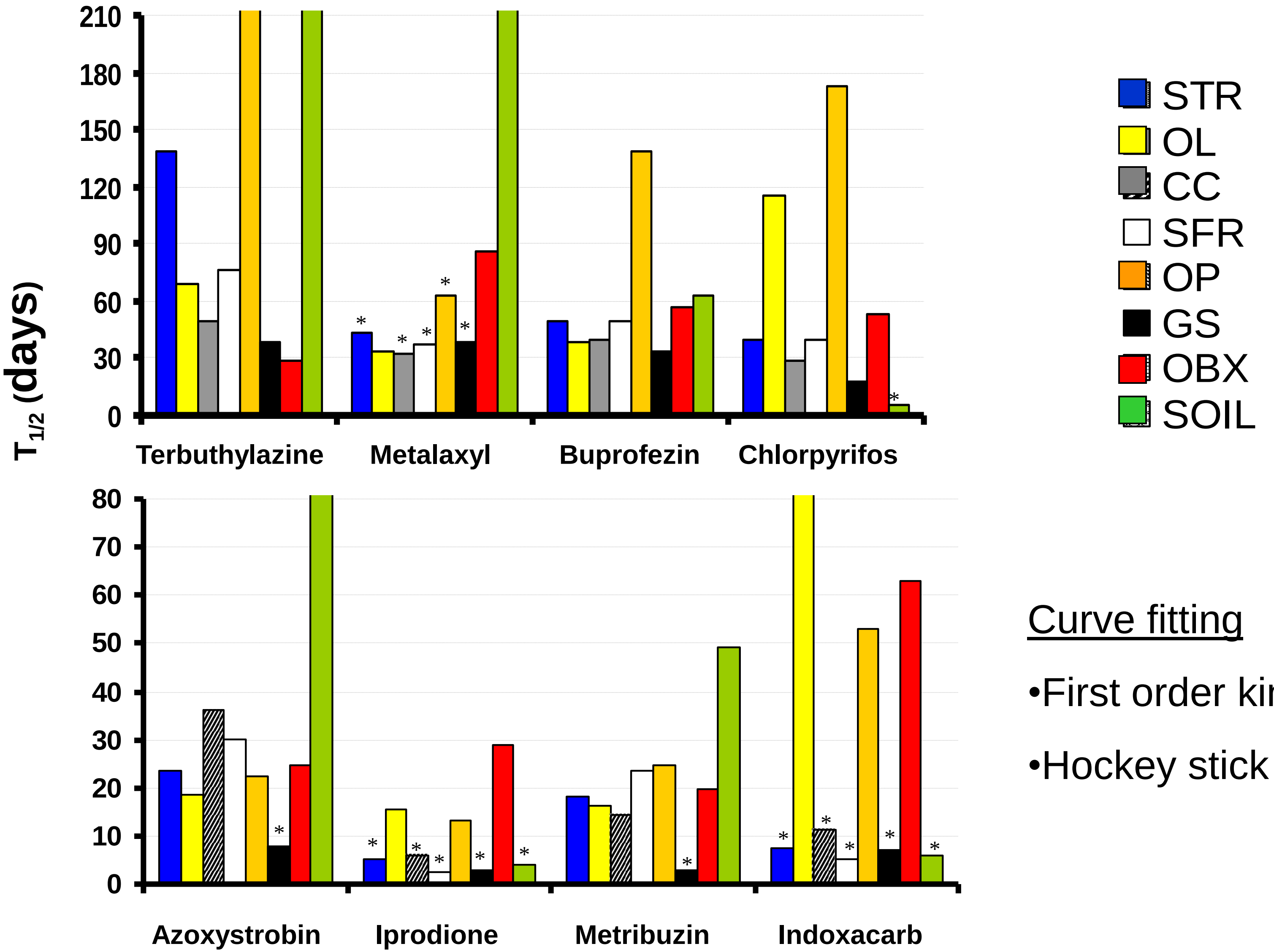
- Soil+ Olive leaves Compost +
  - Straw (STR)
  - Corn Cobs (CC)
  - Sunflower residues (SFR)
  - Grape stalks (GS)
  - Orange peels (OP)
  - Olive leaves (OL)

  (1:1:2)

- Soil

Pesticides
terbuthylazine, metribuzin, metalaxyl, iprodione, indoxacarb, azoxystrobin, buprofezin, dimethoate, chlorpyrifos

Degradation studies - Other lignocellulosic materials instead of straw?



Curve fitting

- First order kinetics
- Hockey stick model (*)

Karanasios et al., (2010) Chemosphere (in press)

Degradation studies - Other lignocellulosic materials instead of straw?

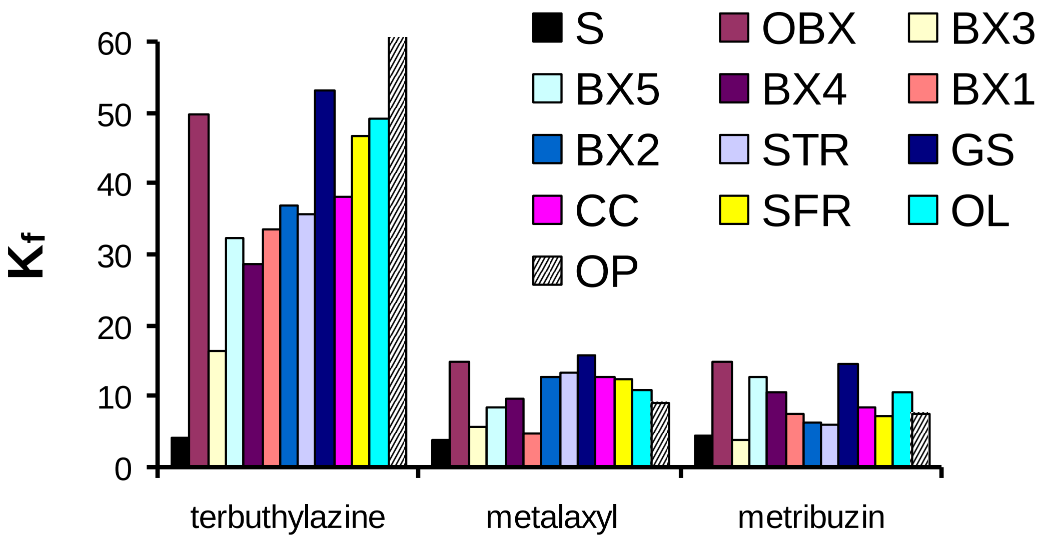
- Higher degradation for all pesticides tested in the **biomixture containing grape stalk (GS)** (*ideal alternative for straw in wine-producing regions in south Europe*)
- Lignocellulosic materials with elevated phenolic content (olive leaves (OL) and orange peels (OP) can lead to severe restriction of the degradation process

Conclusions - Degradation

- **Local composts** instead of **peat** in biomixtures promotes degradation of pesticides

- **Soil : Grape Stalks : Olive leaves Compost** (1:2:1 by volume) appears to be the most promising biomixture regarding degradation efficiency

Sorption studies

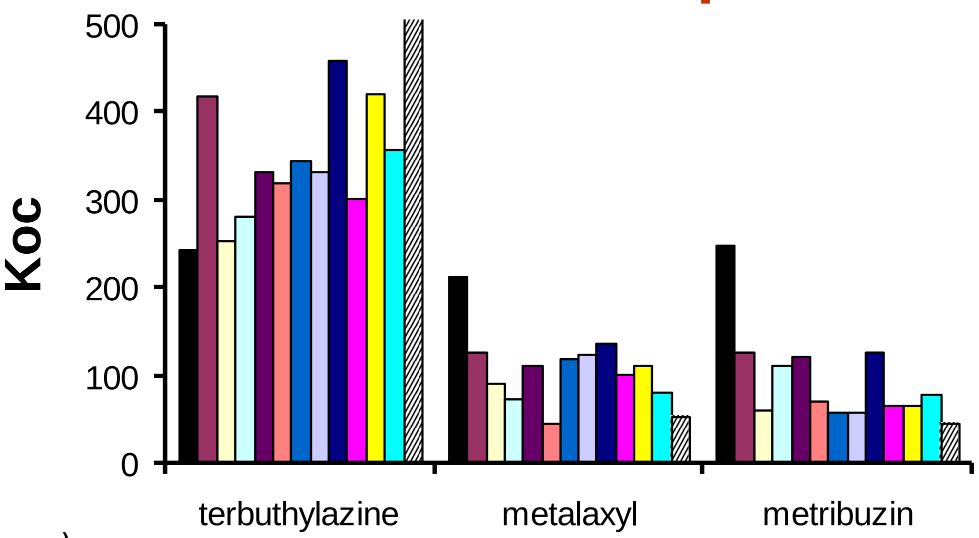


K_f values decreased in the order OBX>BX>soil for all pesticides

Batch equilibrium study

C range : 2-10 μg g^{-1}

r^2>0.95

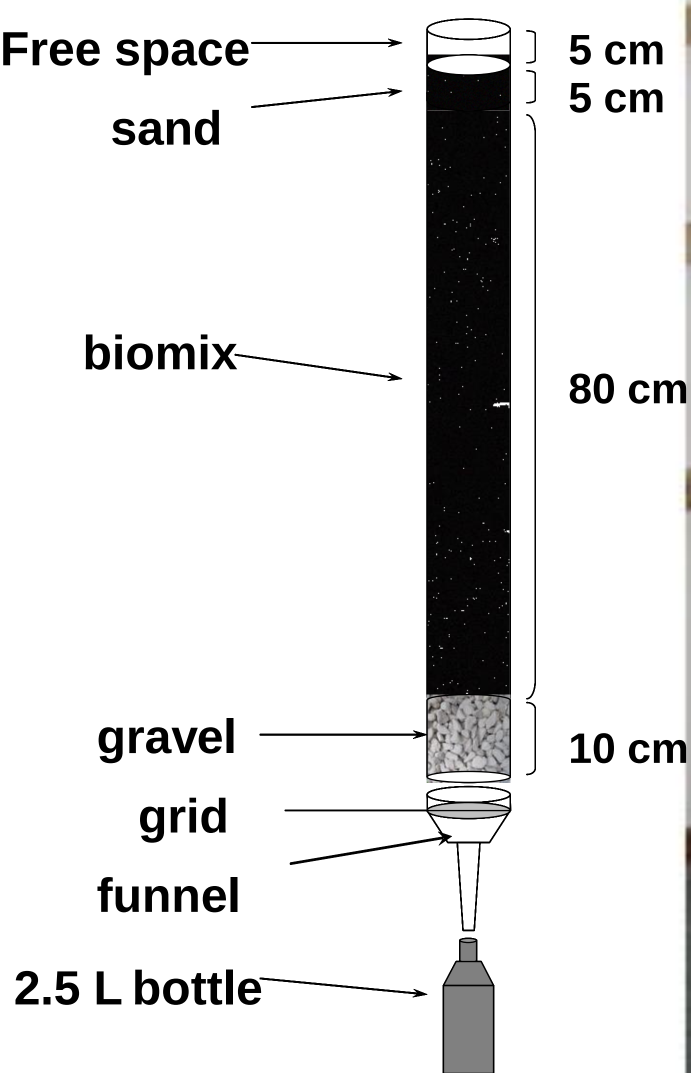


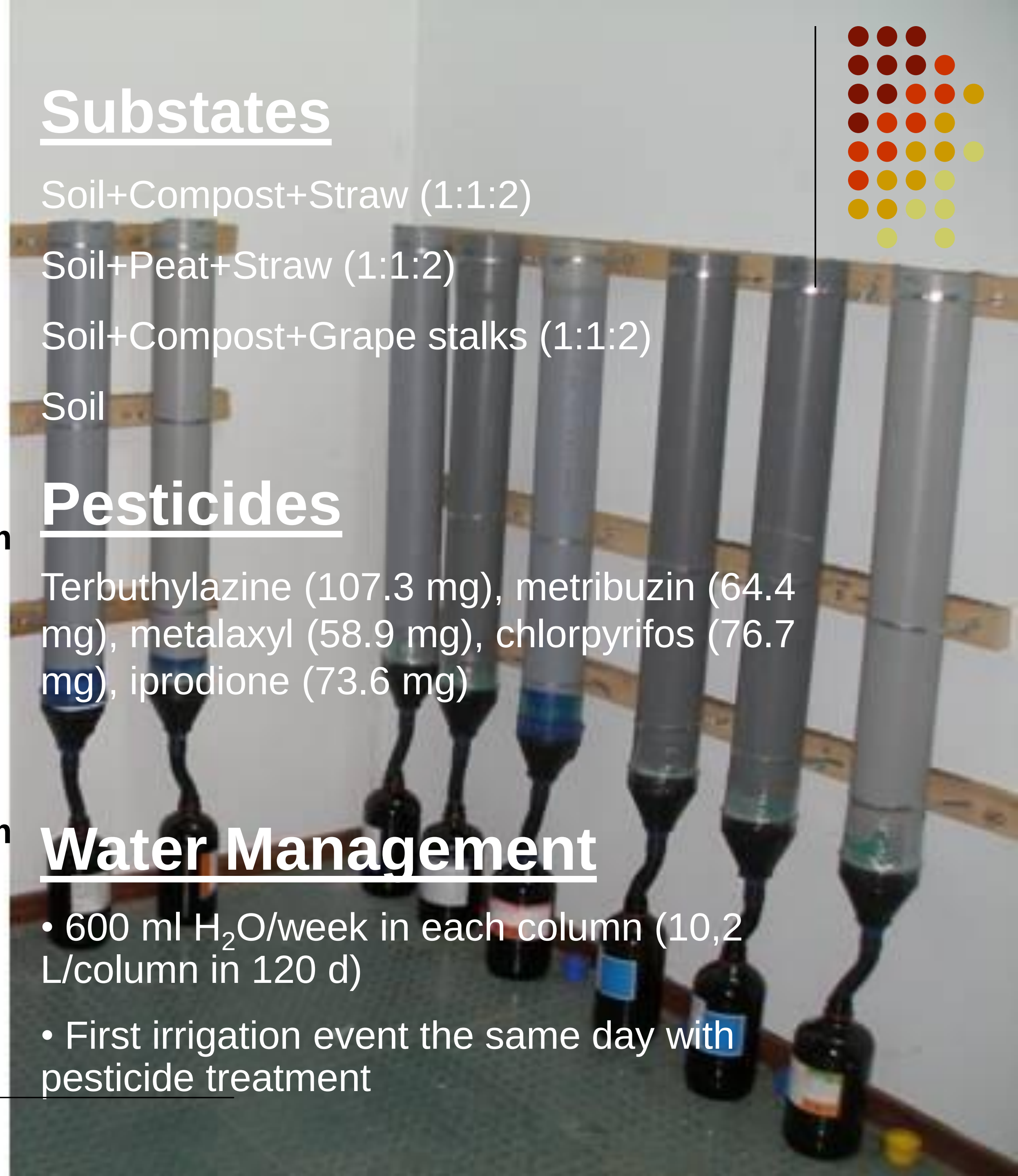
Karanasios et al., (2010) Chemosphere (in press)
Karanasios et al., (2010) J Agric Food Chem (in press)

Phase II

Semi-field studies in leaching columns

Leaching studies





Substates

Soil+Compost+Straw (1:1:2)

Soil+Peat+Straw (1:1:2)

Soil+Compost+Grape stalks (1:1:2)

Soil

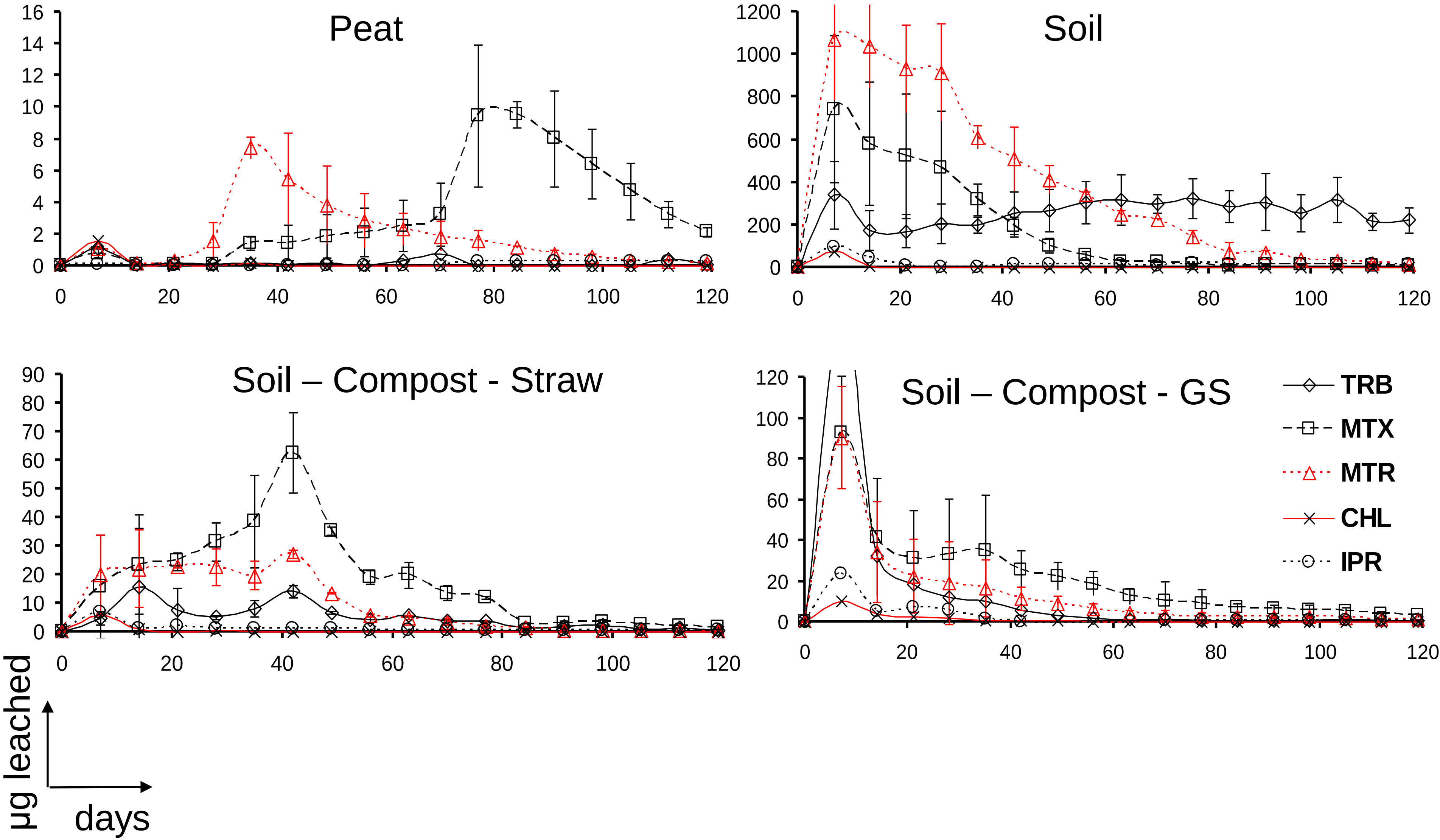
Pesticides

Terbuthylazine (107.3 mg), metribuzin (64.4 mg), metalaxyl (58.9 mg), chlorpyrifos (76.7 mg), iprodione (73.6 mg)

Water Management

- 600 ml H_2O/week in each column (10,2 L/column in 120 d)
- First irrigation event the same day with pesticide treatment

Leaching studies – Breakthrough curves



Leaching studies – mass balance

	Soil				Peat-based biomixture		
	retained	leached	dissipated		retained	leached	dissipated
Terbuthylazine	46.4	4.2	49.5		*tbc*	0.01	*tbc*
Metalaxyl	1.5	5.3	93.3		*tbc*	0.08	*tbc*
Metribuzin	0.8	10.4	88.9		*tbc*	0.05	*tbc*
Chlorpyrifos	0.3	0.1	99.6		*tbc*	0.01	*tbc*
Iprodione	0.0	0.4	99.6		*tbc*	0.01	*tbc*

	Soil-Compost-Straw				Soil-Compost-GS		
	retained	leached	dissipated		retained	leached	dissipated
Terbuthylazine	*tbc*	0.08	*tbc*		*tbc*	0.23	*tbc*
Metalaxyl	*tbc*	0.52	*tbc*		*tbc*	0.60	*tbc*
Metribuzin	*tbc*	0.26	*tbc*		*tbc*	0.35	*tbc*
Chlorpyrifos	*tbc*	0.01	*tbc*		*tbc*	0.03	*tbc*
Iprodione	*tbc*	0.02	*tbc*		*tbc*	0.06	*tbc*

Leaching studies - results

- **<u>Peat-biomixture</u>** showed the lowest leaching, followed by **compost-containing biomixtures** and **soil**

Compost-biomixtures inferior to peat-biomixture but….

1) ***peat-biomixtures are not-applicable in places like Greece***
2) ***Water management of the columns (immediate irrigation after pesticide addition) provided advantage on peat-biomixture over compost-biomixture …….new column study on the way***

Future aims…

- Construction of three pilot on-farm biobeds (offset type) in three agricultural areas in Greece:

  - Thessaly

  - Northern Greece

  - Central Greece

Many thanks….

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