SIXTH FRAMEWORK PROGRAMME

FOOTPRINT

The FOOTPRINT literature reviews

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The FOOTPRINT literature reviews

> First 5 major deliverables of FOOTPRINT

> Different aims depending on the review:

- Extensive review of the literature in a particular field
- Review work to support a novel approach/methodology
- Targeted review on aspects which are poorly documented in the literature (knowledge gap)
  - Because of the lack of science in a particular field
  - Because of the lack of reporting

> Reviews available for download from www.eu-footprint.org/deliverables.html

The 5 topics covered

- ERA for pesticides
- Pesticide fate models and/or environmental indicators
- Bound residues
- Preferential flow
- Mitigation strategies and their effectiveness

Classification of the 5 reviews

	Extensive review	Novel approach	Knowledge gap
ERA for pesticides	✓		
Models and/or env. indicators		✓	
Bound residues	✓	✓	
Preferential flow	✓		
Mitigation strategies			✓

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ERA for pesticides

- A comprehensive & up-to-date one-stop document to ERA which reads really well
- Covers general aspects + GW +SW
- Integrates older (FOCUS) and newer (EFSA PPR) opinions
- Discusses contributions of the various working groups and research projects
- Balances out the benefits and limitations of ERA in the context of pesticide registration
- Provides hints on the future of ERA
- Relates FOOTPRINT & ERA

Pesticide fate models & environmental indicators

- Pesticide fate models
  - Development history
  - Draws general information regarding validation status
    - Calibration usually required to match detailed field behaviour
    - Fit against lysimeter or field data usually ca. 1 order of magnitude
    - Models can generaly been used in a benchmarking context
    - Good fits for multiple-year datasets are rare
    - Degrees of freedom allowing good calibration of the pesticide even where water is inadequately simulated
    - Uncertainty sources numerous and largely ignored
  - Preferential flow in pesticide fate modelling
    - Required to get a good fit to data in most situations
    - Leads to differences in ERA
  - Current and future needs in pesticide fate modelling

Pesticide fate models & environmental indicators

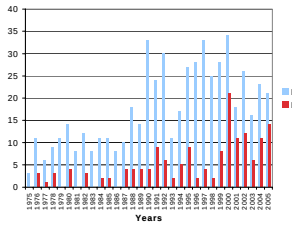
> Environmental indicators
- Information accounted for in EI
- The aggregation of information
- Current and future needs in pesticide fate modelling
- Overview of indicators
- The difficulty of validation

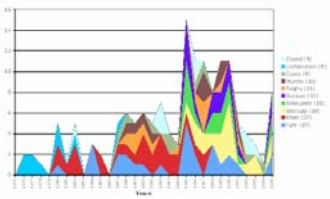
> Conclusion
- Strengths and weaknesses of pesticide fate models and environmental indicators.
- Calls for a closer integration
- Relation to FOOTPRINT tools

Bound residues

> Definition of bound residues

> Bibliometric analysis of the literature





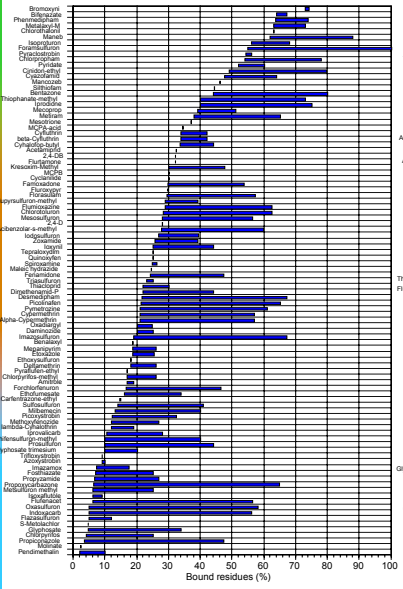
Field: Source Title	Record Count	% of 549	Bar Chart
Journal of Agricultural and Food Chemistry	66	12.0 %	
Chemosphere	38	6.9 %	
Journal of Environmental Science and Health. Part B, Pesticides, Food Contaminants, and Agricultural Wastes	28	5.1 %	
Pesticide Science	22	4.0 %	
Environmental Science & Technology	19	3.5 %	
Journal of Environmental Quality	17	3.1 %	
Environmental Pollution	15	2.7 %	
Environmental Toxicology and Chemistry	12	2.2 %	
Journal of Pesticide Science	11	2.0 %	
Soil Biology & Biochemistry	11	2.0 %	
Drug Metabolism Reviews	10	1.8 %	
Bulletin of Environmental Contamination and Toxicology	8	1.5 %	
Pesquisa Agropecuaria Brasileira	6	1.1 %	
Special issue: non-extractable residues in soil and sediments: characterisation and environmental significance.	6	1.1 %	
und and Conjugated Pesticide Residues; ed. by D.D. Kaufman, G.G. Still, G.D. Paulson, S.K. landal. A symposium sponsored by the Division of Pesticide Chemistry, Colorado, 1975 (ACS Symposium Series 29).	5	0.9 %	
Bulletin of the National Research Centre (Cairo)	5	0.9 %	
International Journal of Environmental Analytical Chemistry	5	0.9 %	
Pest Management Science	5	0.9 %	
Pesticide Biochemistry and Physiology	5	0.9 %	
Residue Reviews	5	0.9 %	
Revista Brasileira de Ciencia do Solo	5	0.9 %	
Biology and Fertility of Soils	4	0.7 %	
Food Additives and Contaminants	4	0.7 %	
man and environmental exposure to xenobiotics. Proceedings of the XI Symposium Pesticide Chemistry, Cremona, Italy, 11-15 September, 1999.	4	0.7 %	
ACS Symposium Series	3	0.5 %	

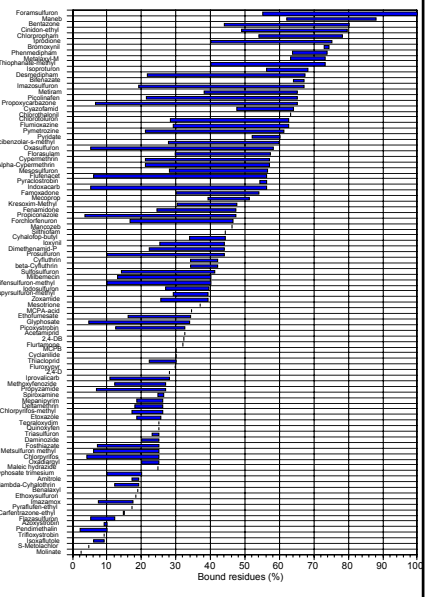
Bound residues

> Proportion of compounds forming bound residues

Pesticide	Initial BR	Rate	Plateau (time)	Maturation (final time)	Reference
2,4-D	< 5 %	High	Yes (10 d)	Release (60 d)	Boivin et al., 2005
Acetochlor	< 5 %	High	Yes (90 d)	Release (371 d)	Loor-Vela et al., 2003
Alachlor	< 5 %	High	Yes (28 d)	Incorporation (80 d)	Laabs et al., 2002
Atrazine	< 10 %	Low	Yes (200 d)	Stable (326 d)	Assaf & Turco, 1994
Atrazine	?	Low	No (180 d)		Winkelman & Klaine, 1991
Atrazine	< 5 %	Low	No (91 d)		Mordaunt et al., 2005
Atrazine	< 10%	High	Yes (60 d)	Release (154 d)	Miller et al., 1997
Atrazine	< 20%	High	No (56 d)		Hang et al., 2003
Atrazine	?	High	Yes (60 d)	Release (360 d)	Nakagawa et al., 1996
Bentazone	< 10 %	Low	Yes (60 d)	Stable (inc.) (160 d)	Boivin et al., 2004
Chlorothalonil	< 40 %	High	Yes (7 d)	Stable (90 d)	Regitano et al., 2001
Chlorpyrifos	< 5 %	Low	No (97 d)		Y□□d et al., 1999
Chlorpyrifos	< 5 %	Low	No (80 d)		Laabs et al., 2002
Cloransulam	< 5 %	High	Yes (120 d)	Release Inc. (357 d)	Wolt et al., 1996
Cyprodinil	< 10 %	Low	No (200d) (yes, 100 d)		Dec et al., 1997
DDT	< 5 %	High	Yes (7 d)	Incorporation (28 d)	Lichtenstein et al., 1977
Deltamethrin	< 10 %	Low	Yes (30 d)	Stable (80 d)	Laabs et al., 2002
Diallate	< 5 %	High	Yes (28 d)	Release (210 d)	Anderson & Domsch, 1980
Dicamba	< 5 %	High	Yes (40 d)	Release (91 d)	Mordaunt et al., 2005
Dicamba	<10 %	High	Yes (14 d)	Release (90d)	Gevao et al., 2005
Dieldrin	< 5 %	Low	No (28 d)		Lichtenstein et al., 1977
Dimethenamid	< 10 %	High	Yes (30 d)	Stable (inc.) (142 d)	Crawford et al., 2002
Dylfonate	< 5 %	High	Yes (14 d)	Stable (28 d)	Lichtenstein et al., 1977
Endosulfan	<20 %	Low	No (160 d)		Monteiro et al., 1989
Endosulfan	< 5 %	Low	No (80 d)		Laabs et al., 2002
Flupropacil	< 5 %	Low	No		Vithala & White, 1996
Isoproturon	< 5 %	Low	Yes (40 d)	Incorporation (91 d)	Mordaunt et al., 2005
Isoproturon	< 10 %	Low	No (40 d)		Benoit et al. 1999
Lindane	< 5 %	Low	Yes (70 d)	Release (91 d)	Mordaunt et al., 2005
Metamitron	< 5 %	High	Yes (28 d)	Release (stable) (84 d)	Mamy et al., 2005
Metazachlor	< 5 %	High	Yes (14 d)	Stable (84 d)	Mamy et al., 2005
Metsulfuron	< 5 %	High	Yes (20 d)	Incorporation (100 d)	Pons & Barriuso, 1998
Monocrotofos	< 5 %	High	Yes (4 d)	Stable (80 d)	Laabs et al., 2002
Paraquat	< 5 %	High	Yes (1 d)	Stable (91 d)	Mordaunt et al., 2005
Parathion	< 5 %	High	Yes (7 d)	Incorporation (28 d)	Lichtenstein et al., 1977
Phosalone	< 5 %	High	Yes (14 d)	Incorporation (84 d)	Ambrosi et al., 1977
Prometryne	< 5%	Low	No (150 d)		Khan & Hamilton, 1980
Propiconazole	< 5 %	Low	No (12 m)		Kim et al., 2003
Prosulfuron	< 20 %	High	Yes (20 d)	Stable (release (105 d)	Hultgren et al., 2002
Simazine	< 5 %	Low	Yes (50 d)	Incorporation (80 d)	Laabs et al., 2002
Sulcotrione	< 5 %	Low	Yes (56 d)	Incorporation (84 d)	Mamy et al., 2005
Tralate	< 5 %	High	Yes (140 d)	Release (365 d)	Anderson & Domsch, 1980
Trifluraline	< 5 %	Low	No (140 d)		Mamy et al., 2005
Trifluraline	< 5 %	Low	No (80 d)		Laabs et al., 2002
Trifluraline	< 5 %	Low	No (91 d)		Mordaunt et al., 2005
Triticonazole	<10 %	Low	Yes (100 d)	Stable (130 d)	Beigel et al., 1999

Bound residues





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Bound residues

- Mechanisms involved in BR formation and nature of BR
- Factors determining the rate of BR formation and the extent of BR (soils, agronomy)
- Reversibility of BR formation
- Proposal for a modelling approach
- *Supporting data provided in annexes*

- A milestone document in the science of BR

Preferential flow

- A comprehensive review on preferential flow
  - Concepts and definitions
  - Generation and maintenance of PF
    - Types of macropores and physical characteristics
    - Biological and chemical properties of macropores
    - Water flow and solute transport of macropores
    - Initial and boundary conditions
  - Macropore flow, horizon properties and morphology
  - Macropore flow and pesticide leaching
  - Soil and crop management practices
  - Macropore flow in the landscape
  - A summary of current understanding
- A targeted review of approaches to preferential flow modelling

Preferential flow

- Proposal for a conceptual model of macropore flow and transport
  - Forms the basis of the methodology to parameterise MACRO from readily available soil information within FOOTPRINT
- What have we got here?
  - An authorative review on preferential flow
  - Statistics of the review
    - 56 pages
    - 284 references
    - Not a single table!
    - One figure on the last page of text (this was close!)

A special focus on:

- Review on mitigation strategies and their effectiveness
- Aim: to fill a knowledge gap in the field of mitigation
- Three questions addressed:
  - What are the various mitigation strategies which can be deployed for various transport pathways?
  - What is the inherent effectiveness of the measures?
  - How do the various measures compare in their effectiveness?
- Will to base the assessments on the basis of scientific information

Feedback on the review

- The review did attract some feedback, as early as two days after it was released
- Two main feedback types:
  - *How could you miss my studies?*
  - *It definitely fills the knowledge gap. Thank you.*
- Positive feedback led to the decision to submit the review for publication

Dissemination of the reviews

- Preferential flow
  - accepted for publication in ***European Journal of Soil Science***
- Mitigation strategies and their effectiveness
  - Submitted to the ***Science of the Total Environment***
- Bound residues
  - Paper in preparation for ***Environmental Science & Technology***
- Pesticide fate models and/or environmental indicators
  - Need for a scientific paper in the future
- ERA for pesticides
  - no specific dissemination plan at this stage

How are the reviews going to be used in FOOTPRINT?

- State of the art:
  - ERA
  - Pesticide fate models and environmental indicators
- Indirect/direct use in FOOTPRINT
  - **Preferential flow:** parameterisation of MACRO from readily available soil data
  - **Bound residues:** current discussion on the possibility to include BR in a MACRO version
  - **Mitigation strategies:** potential use being currently discussed.
    - What mitigation strategies should be implemented to reduce pesticide contamination?
    - What is the likely effectiveness of a particular mitigation strategy?
    - In qualitative terms

Conclusions

- Most reviews directly benefit the work undertaken in the rest of the project
- Some of the reviews are expected to become cornerstones in their field
- Some of the reviews have proposed innovative approaches to a particular scientific question
- Some of the reviews have filled a significant knowledge gap
- All reviews remain accessible to those interested in the fate of pesticides in the agricultural landscape

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