Pesticide related monitoring studies in Germany

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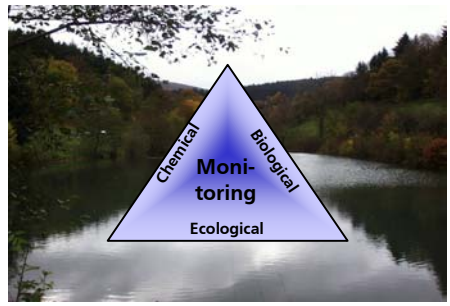
Introduction

In the last 10 years, different monitoring studies have been conducted in Germany to analyse the effects of pesticides on non-target organisms. In addition, several studies focused on the measurement of pesticide concentrations in surface waters or non-target areas. The objective of the project presented here is to summarize and evaluate these studies in a uniform way and to discuss the relevance with respect to the current practise of pesticide registration.

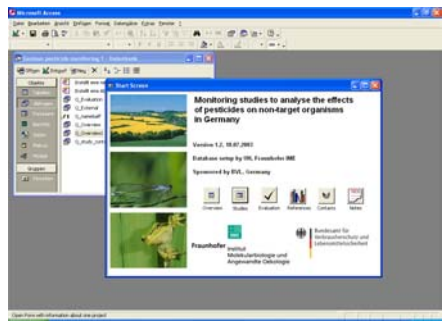
For this review, monitoring is differentiated into chemical (measuring chemical concentrations in the field), biological ('active monitoring', measuring the response of test organisms to samples taken or exposed in the field), and ecological monitoring ('passive monitoring', measuring species abundances and community structure in the field).



Database

Information about monitoring studies is obtained from publications, reports, presentations on conferences and personal communication. Within a database, two hierarchical levels are used to structure the data:

The term project is used in the sense of the organisation / funding of research activities, e.g. an activity of several partners. Studies are used to describe methods and results of a project in more detail: For example chemical, biological and ecological monitoring are handled as separate studies within a project. In a similar way, projects conducted in different regions are also splitted into studies to facilitate the comparison of results from different projects for one region.



Preliminary results

Tab. 1 gives an overview over the 34 projects and their main characteristics which have been recorded until now. Nearly all studies include chemical monitoring but some conducted ecological monitoring only. In most of the studies the focus was on exposure and effects in water bodies, mainly ditches or streams close to agricultural land. Information entered for a project, but not shown in Tab. 1, refer to the objectives of the project, the principal approach, co-factors measured (e.g. water quality, habitat structure, weather conditions), the definition of controls, and the general conclusions drawn by the authors.

An example for the description on the lower, more detailed level of studies is given in Tab. 2. Three institutes analyse(d) the effects of pesticides in ditches of the "Altes Land", an orchard region close to the river Elbe near Hamburg: While the NLÖ (Lower Saxony Agency of Ecology) focused on chemical monitoring, the BBA (Federal Biological Research Centre for Agriculture and Forestry) conducted chemical, biological, and ecological monitoring within two projects. The Fraunhofer IME made no measurements of pesticide residues, but related the macroinvertebrate community structure to an estimated potential of exposure.

Tab. 1: Projects included in the database yet

Affiliation	Shortname	Chemical	Biological	Ecological	Co-factors	Aquatic	Soil	Terrestric	Time period
ALR Kiel	Entry of glyphosate into small streams	X				X			
BBA	Uckermark project	X		X		X			2000-2005
BBA	Terbuthylazine run-off	X				X			1999-2002
BBA	Run-off into non- target areas	X				X		X	
BBA	Pyrethroid in ditches					X			
BBA	Pesticides in rain, surface- and groundwater	X				X			
BBA	Pesticides in ponded depressions in NE Germar	X	X			X			
BBA	Pesticide residues and effects on earthworms	X		X			X		
BBA	Monitoring the run-off of selected herbicides	X						X	2003 - ?
BBA	Lamspringe project 2	X				X			1999-2001
BBA	Insecticide drift and effects on zooplankton	X	X	X		X			2000, 2001
BBA	Effects on non-target plants			X				X	
BBA	Effects of KARATE on non-target arthropods	X		X	X			X	1998 - 2001
BBA	Effect of Dicofol in ponds	X		X		X			
BBA	Deposition of insecticides	X			X	X			2000
BBA	Biological monitoring of KARATE drift effects	X	X			X		X	
BBA	BBA chemical-biological monitoring in the AL	X	X	X	X	X			2001 - 2003
BBA	ARELON spike experiment	X	X			X			
DVKW	Pesticide entry in the Nachtweidegraben	X		X		X			1985-1989
Gelsenwasser	Pesticides monitoring in the Stever region	X		X		X		X	1999, 2000
IFZ Giessen	Pesticide effects on field margins			X				X	
IME	Pesticide volatilization	X					X	X	1995
IME	IVA monitoring in the AL			X	X	X			1998-2000
IME	IVA Braunschweig streams monitoring			X	X	X			1998-2000
IME	Herbicide run-off	X					X		
LA Pflanzenbau	Pesticide drift into non-target areas	X						X	1998 - 2001
LfU BW	Pesticides in rivers of Baden-Württemberg	X				X			2001
LG Landwirtsch	Ditches in Nordstrand			X		X		X	1999 - 2001
NLÖ	NLÖ long-term monitoring in the AL	X		X	X	X			2001 - ?
PSA Hannover	Lamspringe project 1	X	X	X	X	X			1995 - 1999
RWTH Aachen	Biocoenoses in off-crop sites	X		X			X	X	2000 - 2003
STAWA Münst	Pesticide entries in the Frischhofbach	X				X			1991
Syngenta	Ponds in Braunschweig			X		X			2000, 2001
TU Braunschw	TU Braunschweig stream monitoring	X		X	X	X			? - 2001

Institute	Project (short name)	Monitoring	Sampling period	Methods	Chemicals monitored	Organisms monitored	Number of sampling sites	Samples per site	Other factors, co-variables per site	Statistical methods used	Results
BBA	BBA chemical-biological monitoring in the AL	Chemical	2001 - 2003	Automatic daily samples in 2001, pooled to weekly sample; hand-drawn samples after application, since 2002 only hand-drawn samples; calculation of toxic units	approx. 70 plant protection products		3 (2001) respectively 5 (2002) ditches	total n 2001: 37 2002: 110	distance, width, depth, temp, pH, O2, conduct, N, PO4, Ca	no	2001: active substances found in all samples, also some which were not applied; conc between 0.05 and 50.8 µg/L; target conc (1/10 NOEC) exceeded in about 7% of the 68 substances monitored; in three cases, conc higher than lowest NOECs; beta-cyfluthrin in Neuenkirchen around the LC50
		Biological	2002	Acute Daphnia toxicity tests using water samples		Daphnia magna				no	In 2002, 84 % of all samples without subacute effects on Daphnia, despite the fact that up to 12 different active substances in one water sample were found => effects from drift are negligible
		Ecological	2001 - 2003	Monthly (4 2001 - 10 2002) sampling of macrozoobenthos in water & sediment, zooplankton		Zoobenthos, Zooplankton	3 (2001) respectively 5 (2002) ditches	2001: 7; 2002: 4, 2003: 4	distance, width, depth, temp, pH, O2, conduct, N, PO4, Ca	Shannon index, no tests	2001: 90 - 103 taxa per ditch (144 in total) including sensitive taxa; lowest number of species and abundances in Neuenkirchen, the ditch with the highest pesticide concentrations
BBA	Insecticide drift and effects on zooplankton	Chemical	2000, 2001	Ditch in Neuenkirchen 3 approaches: A: Normal application, B: drift reducing measures, C: control	2000: Delta-methrin, 2001: beta-cyfluthrin,	Zooplankton	3 areas along 1 ditch	9 samples within 7 days after appl		no	Initial concentrations: deltamethrin: A: 0.57 µg/L, B: 0.06 µg/L; beta-cyfluthrin: A: 1.94 µg/L, B: 0.14 µg/L; deltamethrin DT50 = 5 resp 6 days; beta-cyfluthrin DT50 = 3.6 - 3.8 days; A: average drift 27.1 %, B: 2.3%; in approach B approx. 10 % drift entry compared to A
		Biological	2001	Beakers with *D. magna* placed in the first and second row of the trees and floated in the ditch; measuring immobility after 24 and 48 h	BULLDOCK (beta-cyfluthrin)	*Daphnia magna*	3 areas along 1 ditch		?	no	A: 100 % immobility in the ditch and within orchard; B: 40 % in immobility in the ditch, upt to 75 % in 2. tree line, ca. 50 % in 1. tree line; C: control: up to 20 % immobility
		Ecological	2001	Zooplankton sampling (in total 720 samples, 04-06.2001)	BULLDOCK (beta-cyfluthrin)	Zooplankton	3 areas along 1 ditch	12 samples per approach	?	no	Small effects only on copepods in variant A, recovery within 3 weeks; => acceptable effects on zooplankton; drift mitigation techniques and 5 m distance seem to protect water organisms
IME	IVA monitoring in the AL	Ecological	1998 - 2000	Sampling of zoobenthos; measurements or estimation of chemical water parameters and structural parameters; calculation of a potential of exposure based on distance to trees and water volume	no	Macrozoobenthos	40 ditches	5 samples	habitat, water chemistry, land use	univariate, classification, ordination	Clear and long lasting effects only in the ditches with distance to the trees <= 1.5 m; strongest effects in summer with trends of recovery in next spring; effects observed for presence and abundance of species and community structure; => no permanent significant effects on aquatic macroinvertebrate communities if distance to trees >=3 m.
NLÖ	NLÖ long-term monitoring in the AL	Chemical	2001 - 2003	Event based residue analysis (max 2 days after application)	org pesticides, copper		3 ditches + Lühe (stream)	5 dates,4 subsamples,	application characteristics	?	Report not available yet
		Ecological	2001 - 2003	3 subsamples per site of a distance between 40 - 50 m	org pesticides, copper	Macrozoobenthos	3 ditches	2 dates per year	?	?	Report not available yet

Tab. 2: Studies conducted in the "Altes Land", preliminary entries

Outlook

Presently, the collection of information and entering into the database is an ongoing process. Therefore, if you know about monitoring projects not included in Tab. 1, your support is very much appreciated (email: hommen@ime.fraunhofer.de). Later on, the projects will be evaluated with respect to the relevance of the findings for the registration process (e. g. based on the possibility of extrapolating to other regions, land use, ecosystems) considering also the findings and recommendations of the EPIF workshop.

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