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Report from the 'Vemmenhög-project' 1995-1996

Pesticide concentrations and transport in water from a small agricultural catchment in southern Sweden

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Errata

Page	Paragraph	Line	Reads	Should read
9	1	1	analysis	analyses
14	2	2	152	158
14	2	2	66	65
17	Table 3	10	250	277
17	Table 3	10	1.0	1.1
17	Table 3	14	250	277
17	Table 3	14	1.0	1.1
20	2	5	About *ca.*	About
24	3	1	1994	1993
35	2	1	five	three

Appendix 3. Row 12 (in table). Reads: 879. Should read: 324.
Reads: 0.59. Should read: 1.59.

Appendix 9. Page: 6 (6). Column heading: tribenuron-methyl. Row: 5.
Reads: 0.0. Should read: n.a.

Amendment

Page 7. Paragraph 3. pH-value in tile drainage and stream flow is in the range of 7.5-8.0.

Page 8. Paragraph 3. Row 4. ...with ethanol, and stored during the collection procedure at +4°C in the sampler refrigerator.

Appendix 7. Pesticide concentrations are given in µg/l.

Contents

SAMMANFATTNING

Uttransport av bekämpningsmedel från ett mindre avrinningsområde i södra Skåne, sydväst om Skurup, har studerats sedan 1990. Området, med *ca* 95% åker, ingår i SNVs miljöövervakningsprogram 'Typområden på jordbruksmark'. Detaljerad information om användningen av bekämpningsmedel i området har samlats in genom årliga intervjuer med lantbrukarna. I föreliggande rapport presenteras användningen av bekämpningsmedel i området, samt halter och transporterade mängder av dessa bekämpningsmedel i vatten från den kulverterade delen av området (828 ha) under perioden maj-november 1995 och 1996.

Vädret har varierat under tvåårsperioden, med nederbördsmängder över det normala under första halvåret 1995 och under det normala de resterande 18 månaderna. Vintern 1995/96 var kall och med nederbörd främst som snö. Årsavrinningen var låg jämfört med tidigare år under både 1995 och 1996. Användningen av bekämpningsmedel i området har i medeltal uppgått till 1 200 kg aktiv substans per växtodlingssäsong, varav *ca* 40% spreds under hösten och *ca* 60% under våren och försommaren. Andelen bekämpningsmedel som spreds under hösten var högre än tidigare år, speciellt under 1995/96. Av de totalt 32 olika aktiva substanser som användes i området, ingick *ca* 90% (vikts-%) av dessa i analysmetoderna, vilket är något mindre jämfört med tidigare. Detektionsgränsen för flertalet substanser låg i intervallet 0,1-0,5 µg/l.

Totalt 27 olika bekämpningsmedel detekterades i vattenprover under perioden, varav 21 ogräsmedel, 2 svampmedel, 3 insektsmedel och en nedbrytningsprodukt. Vanligast förekommande var ogräsmedlen terbutylazin, diflufenikan, metazaklor, mekoprop, atrazin, etofumesat, isoproturon och bentazon, samt svampmedlet propikonazol. Detekterbara halter av bekämpningsmedel förekom i samtliga vattenprover, med en summakoncentra-tion på i medeltal *ca* 10 µg/l, vilket är lägre än tidigare uppmätt. Vissa bekämpningsmedel som spreds under hösten, bl.a. isoproturon och metazaklor, återfanns i vattenprover insamlade under efterföljande vår och sommar, vilket tyder på att de fanns kvar i markprofilen under lång tid efter användningstillfället.

Den totala förlusten av bekämpningsmedel från området under maj-november 1995 och 1996 var *ca* 0,7 kg under båda åren. Denna mängd bestod till 18% av bekämpningsmedel som använts för ogräsbehandling på gårdsplaner, samt ytterligare 2% från okänd användning. Resterande 80% utgjordes av bekämpningsmedel som använts för bekämpning i fält. Den totala uttransporten från området har påtagligt minskat sedan undersökningen inleddes, vilket främst kan tillskrivas den minskade användningen av bekämpningsmedel på våren under senare år.

Förlusten för ett enskilt bekämpningsmedel motsvarade vanligen *ca* 0,1% eller mindre av den mängd som använts i området under våren och försommaren. I genomsnitt för alla substanser var förlusten 0,03% under maj-september 1995 och 0,08% under motsvarande period 1996. Dessa förluster var i samma storleksordning som uppmätts tidigare år.

Undersökningen visar att uppmätta halter av vissa bekämpningsmedel i ytvatten i små, jordbruksintensiva avrinningsområden under kortare perioder är nära, och i vissa fall överskrider, de halter som i andra studier visat sig ha negativa effekter på flora och fauna i vattenmiljön. För flertalet substanser är dock halterna vanligen lägre än de i litteraturen angivna skadliga koncentrationerna för känsliga akvatiska organismer.

SUMMARY

A pesticide monitoring study was initialized in spring 1990 to examine the loss of pesticides in stream water from an agricultural catchment in southern Sweden under normal management practices. Information on pesticide usage was collected annually through interviews with the 35 farmers operating in the area. In the present report results are presented on pesticide usage in the catchment and the occurrence and transport of pesticides in water leaving the area during May-November in 1995 and in 1996 .

The weather during the investigation period varied, with precipitation amounts above normal during the first half of 1995 and below normal during the remaining one and a half year. The winter 1995/96 was cold and with a snow cover during extended periods. Flow volumes in 1995 and 1996 were considerably less than the average for the whole period.

The total amount of pesticides applied in the catchment was on average 1200 kg active ingredient (AI) per year, with *ca.* 40% applied in the autumn and *ca.* 60% during spring/early summer. The relative amount of pesticides applied in the autumn was higher than in previous years, especially during the 1995/96 growing season. Of the 32 pesticides used in the catchment, *ca.* 90% (by weight) were included in the analysis, which is a slightly less compared to recent years.

During the investigation period 27 pesticides were detected in water samples, including 21 herbicides, 2 fungicides, 3 insecticides and 1 metabolite. The most frequently detected pesticides in water were: terbuthylazine, diflufenican, metazachlor, mecoprop, atrazine, ethofumesate, propiconazole, isoproturon and bentazone. Detectable concentrations of pesticides in culvert discharge were observed throughout the sampling periods, with average total pesticide concentrations (*ca.* 10 μg/l) generally lower than detected earlier in samples from the same site. Pesticides applied in the autumn prevailed in water collected during the following spring and summer.

Total load of pesticides transported in water leaving the area during May-November in 1995 and 1996 were *ca.* 0.7 kg in both years. Of this amount, pesticides used on courtyards constituted 18% and another 2% was made up of pesticides originating from unknown sources. The remaining 80% of total amounts of pesticides detected in water originated in field use. The total pesticide load in water has decreased markedly since the onset of the investigation seven years ago, in compliance with decreased amounts applied during spring and early summer.

Losses of single pesticides used in the field were generally less than 0.1% of the applied amount during individual years; the average loss during May-September was 0.03% in 1995 and 0.08% in 1996. These losses were comparable with those registered previously.

The results indicate that concentrations of some pesticides entering headwater streams in agricultural areas are close to, and during certain time periods even above those levels demonstrated to have an impact on the aquatic flora and fauna.

INTRODUCTION

A pesticide monitoring study was initialized in spring 1990 to examine the loss of pesticides from an agricultural catchment in southern Sweden under normal management practices. The results from the first five years, 1990-1994, were presented in an earlier report (Kreuger, 1996). In the present report results of pesticide occurrence and transport in water during 1995 and 1996 are presented. The catchment is part of the Swedish environmental monitoring program 'Typområden för jordbruksmark' with the aim to investigate agricultural impact on water quality in small agricultural catchments throughout Sweden. Results of nutrient losses from the catchment are reported elsewhere (Kyllmar et al., 1996).

MATERIAL AND METHODS

A complete description of the catchment, data collection procedures, techniques and calculations, analytical procedures and quality assurance is given in Kreuger (1996). A brief description will be given below.

Catchment description

The Vemmenhög catchment is located in the far south of Sweden on the south-western plain of Skåne (Scania province). It forms the upper reach of the Vemmenhögstream drainage basin which empties into the Baltic Sea. The catchment has undulating topography with glacial till-derived soils rich in chalk. It has an area of 9 km^2 (902 ha) consisting of 95% arable land, with sandy loam soils dominating. Extensive tile-drainage systems have been installed within the area.

Data collection

Information on crops, fertilization and pesticide usage (i.e. type of pesticides used, dosage, time of spraying and location) was collected annually through interviews with the 35 farmers operating in the catchment area. Only one farm with 2.5% of the arable land did not participate in the investigation.

Throughout the upper part of the catchment, drainage water is channeled through a large culvert, apart from a small open ditch with a length of 100 m. The culvert collects primarily tile drainage, but can also, as customary in tile-drained areas, carry runoff water due to surface runoff inlets along the tile drains in the field. Surface runoff inlets can also be found on some courtyards and along roads. During 1995-1996, water samples for pesticide analysis were collected from site UT10, situated at the outlet of the culvert (**Figure 1**). The drainage area at this site is 828 ha. Sampling periods were May-November each year, with interruption during low-flow periods.

Water flow rates at the culvert outlet (UT10) were measured using a 90-degree V-notch weir and an ultrasonic sensor (ISCO model 3210 flow meter with plotter).

Rainfall was measured on a daily basis, both within the catchment (one gauge situated close to site NA1 and the other by the village close to site SH5) as well as at an official meteorological station located 6 km to the north-east of the catchment. During certain time periods, rainfall was registered on an hourly basis by data loggers using tipping bucket rain gauges, one situated at LU12 (Campbell datalogger) and one by the village close to SH5 (ISCO 674L datalogger) (**Figure 1**).

Water samples were collected using a programmable automatic sampler with refrigerator (ISCO model 3700FR). The sampler collected time-paced samples at weekly intervals, each sample being a composite of sub-samples taken at hourly intervals. Samples were collected in glass bottles, prewashed with ethanol. To inhibit microbial degradation of the pesticides during the collection period, dichloromethane was added to the sampling bottles in advance, plus distilled water to prevent evaporation losses of the dichloromethane. After the completion of the sampling program, the bottles, capped with Teflon-lined screw caps, were delivered to the laboratory within 48 hours and extracted within 24 hours of delivery.

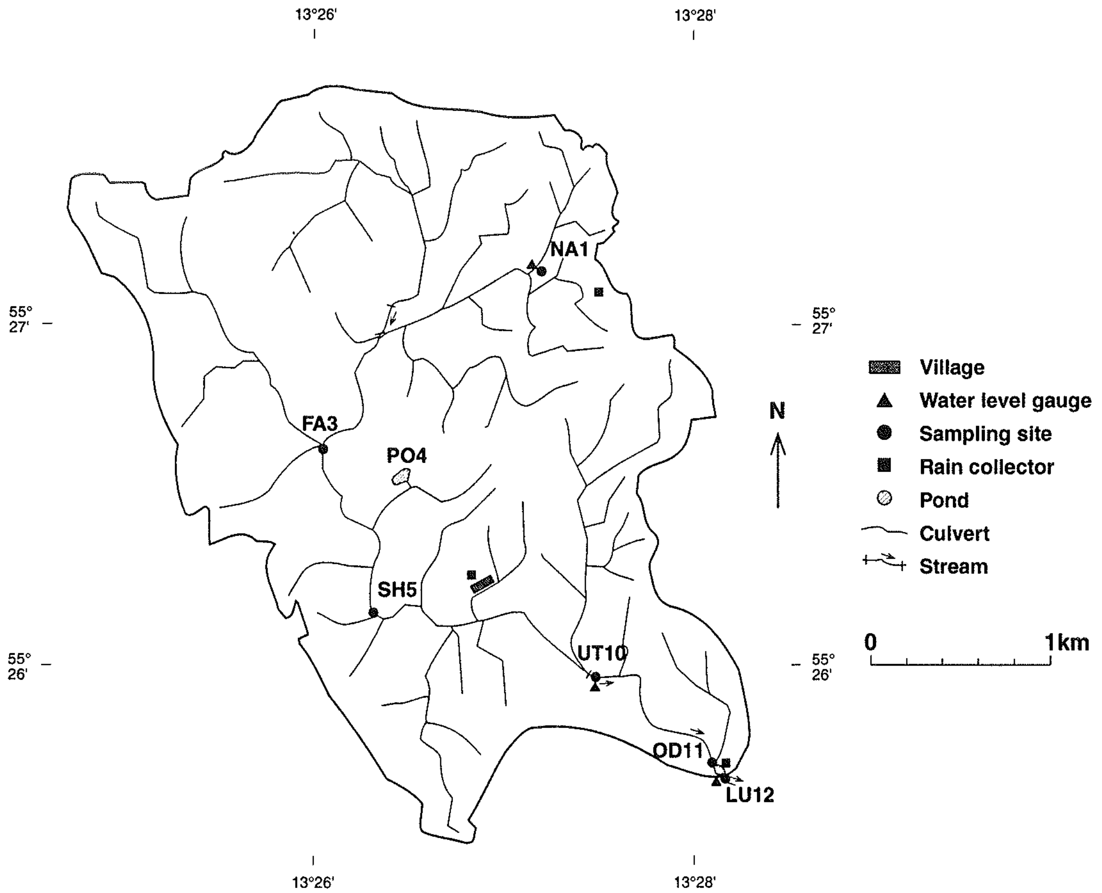

Figure 1. Location of sampling sites and measurement devices in the catchment area.

Analytical procedures

Pesticide residue analysis were conducted by the Organic Environmental Chemistry Unit, Department of Environmental Assessment at the Swedish University of Agricultural Sciences, Uppsala. Unfiltered water samples were analyzed by two different procedures, the phenoxy acid method and the multiresidue method (Åkerblom et al., 1990). Thereby about 80 different pesticides can be detected. Samples were spiked with surrogate analytes to monitor the accuracy and precision of the analytical procedures. The analyses were performed using gas chromatography and mass spectrometry (GC/MS), with a recovery efficiency of most substances in the range 75-100%. The results reported were not corrected for recovery efficiency. The limit of determination for each pesticide and year is given in **Table 6**.

Quality assurance

The general conclusion of previous studies on pesticide stability during sampling and storage was that the procedures used were adequate, with recoveries within the normal variance of the analytical procedure.

To evaluate the possible impact on stream water quality of pesticide spills on courtyards, bromide was applied as a tracer on a courtyard in 1995. On 7 May, 2.8 kg of bromide in 25 liters of water was spread on a 25 m^2-area, with the closest distance to a surface water inlet of 8 meters.

In June 1996, a glass bottle filled with distilled water (and dichloromethane) was stored with the cap off in the automatic water sampler during a three-week period to check if any contamination from external sources occurred during the collection procedure.

RESULTS

Weather

Table 1 and **Figures 2 and 3** summarize the climatic data during the study period. The annual precipitation in the area was 653 mm in 1995 and 537 mm in 1996. The long-term (1961-1990) average value is 662 mm. Both in 1995 and in 1996 there were long periods with precipitation amounts below normal. Between December 1995 and early April 1996 precipitation was as snowfall. In 1995, precipitation amounts were mainly above normal until July when there was a change to warm and dry weather. In 1996 monthly amounts of precipitation were below or close to normal throughout the year, apart from May receiving almost three times the normal precipitation.

Table 1. Monthly precipitation totals, monthly average temperature and departure from normal, along with monthly flow totals, during sampling periods 1995-1996

Month	Prec.* mm	Dep.° mm	Temp.# °C	Dep.° °C	Flow^ mm
1995					
May	52	+12	9.2	-1.4	7.6
Jun	67	+13	14.2	-0.2	7.9
Jul	28	-36	17.8	+1.8	1.0
Aug	15	-44	18.1	+2.4	0.1
Sep	106	+41	12.8	+0.5	0.5
Oct	43	-23	11.0	+2.4	0.4
Nov	29	-47	2.4	-1.6	1.4
1996					
May	115	+75	9.1	-1.5	8.7
Jun	36	-18	14.4	±0.0	2.3
Jul	65	+1	15.1	-0.9	0.6
Aug	23	-36	17.9	+2.2	0.1
Sep	73	+8	10.8	-1.5	0.2
Oct	37	-29	9.7	+1.1	0.2
Nov	71	-5	4.7	+0.7	2.6

* Precipitation measured at an official meteorological station in Skurup, 6 km NE of the catchment.
° Departure from 'normal'. 'Normal' is the 30-year average precipitation measured at Skurup and temperature measured at Sturup.
\# Temperature measured at an official meteorological station in Sturup, 12 km NW of the catchment.
^ Flow measured at sampling site UT10.

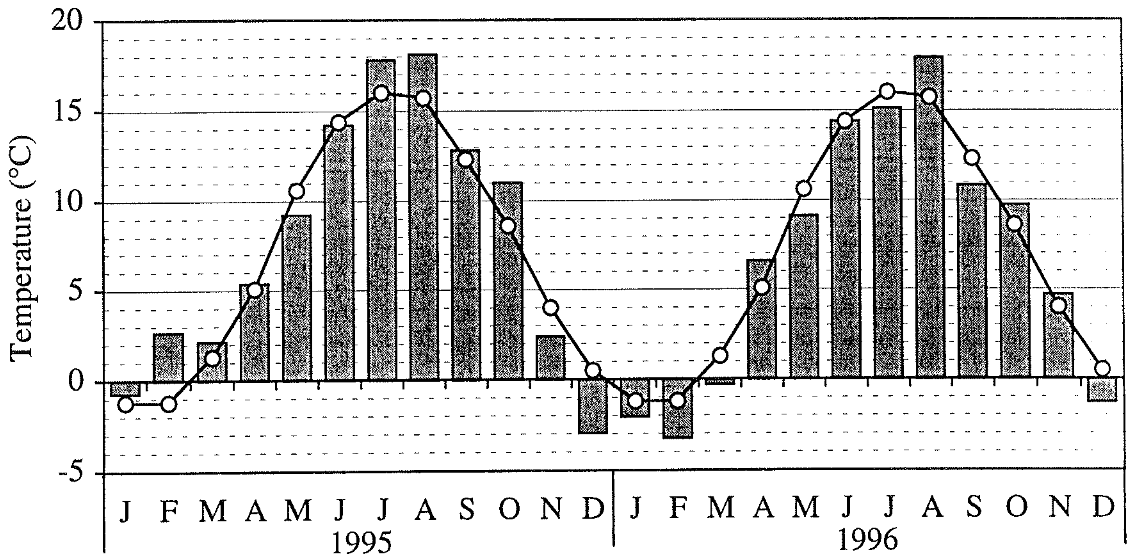

Figure 2. Monthly average temperature during 1995-1996, with the 30-year monthly average temperature indicated as a curve.

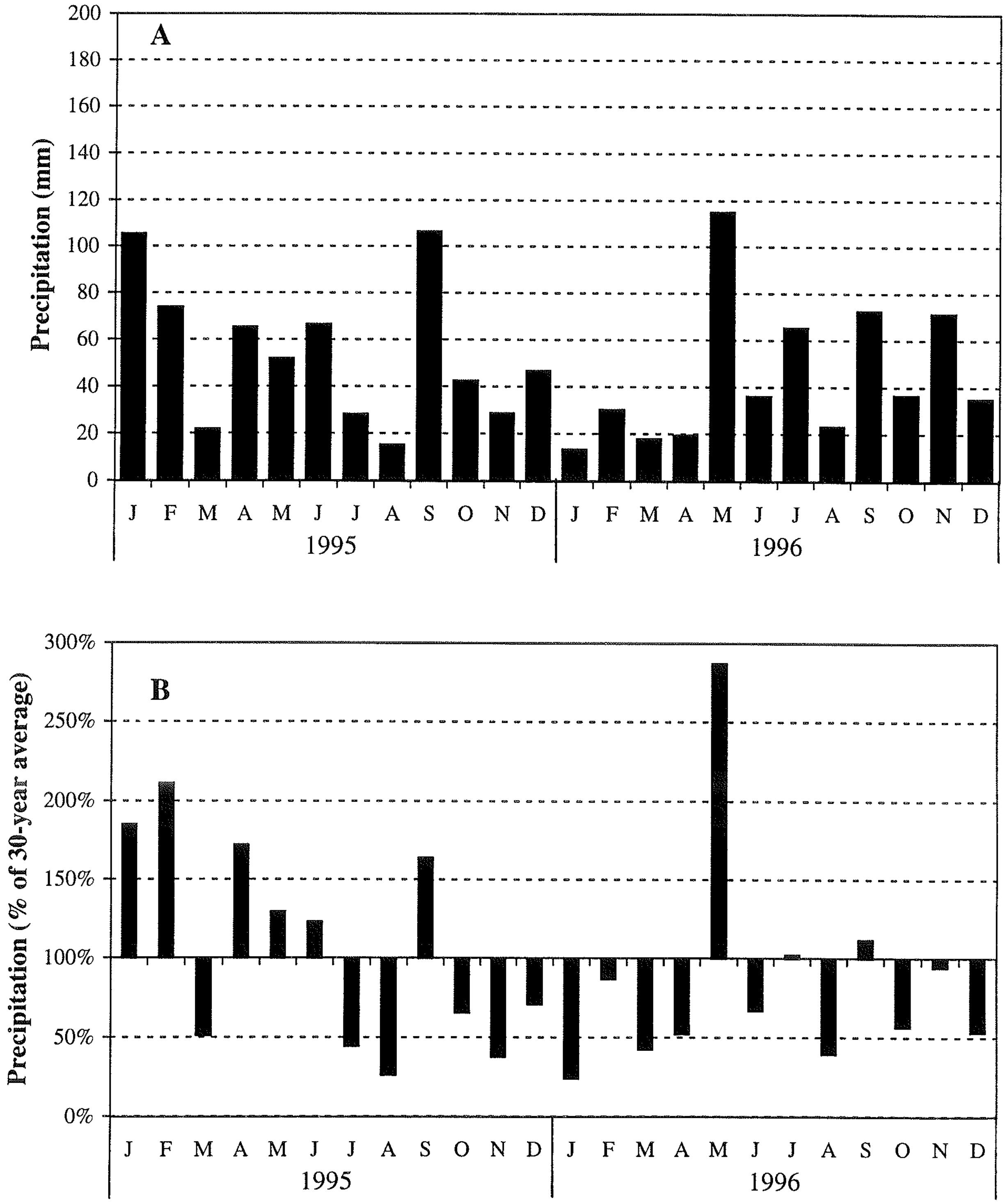

Figure 3. A) Monthly precipitation totals. B) Precipitation as departure from normal (30-year average measured 1961-1990).

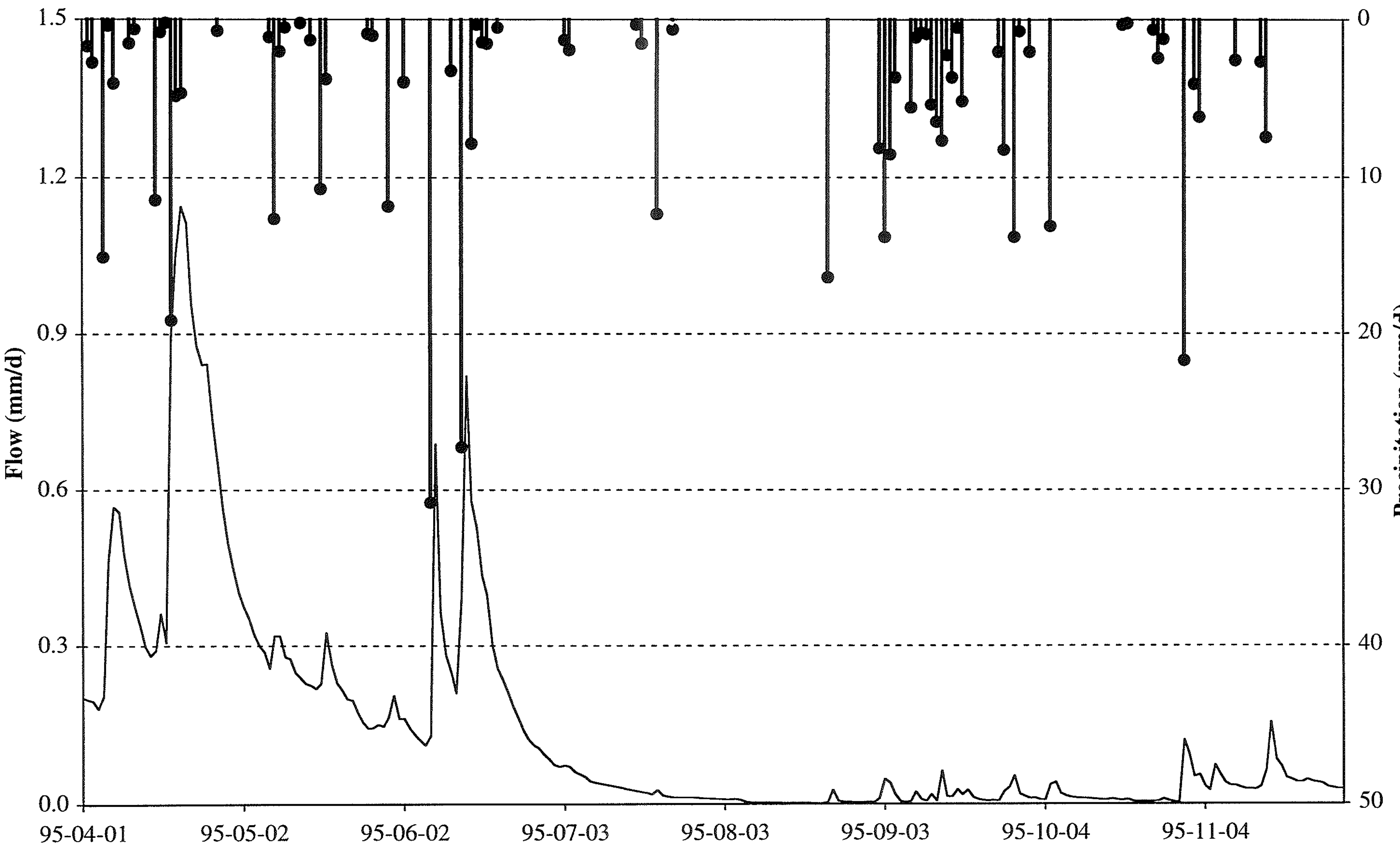

Figure 4. Waterflow measured at sampling site UT10 and precipitation in the area during April-November in 1995.

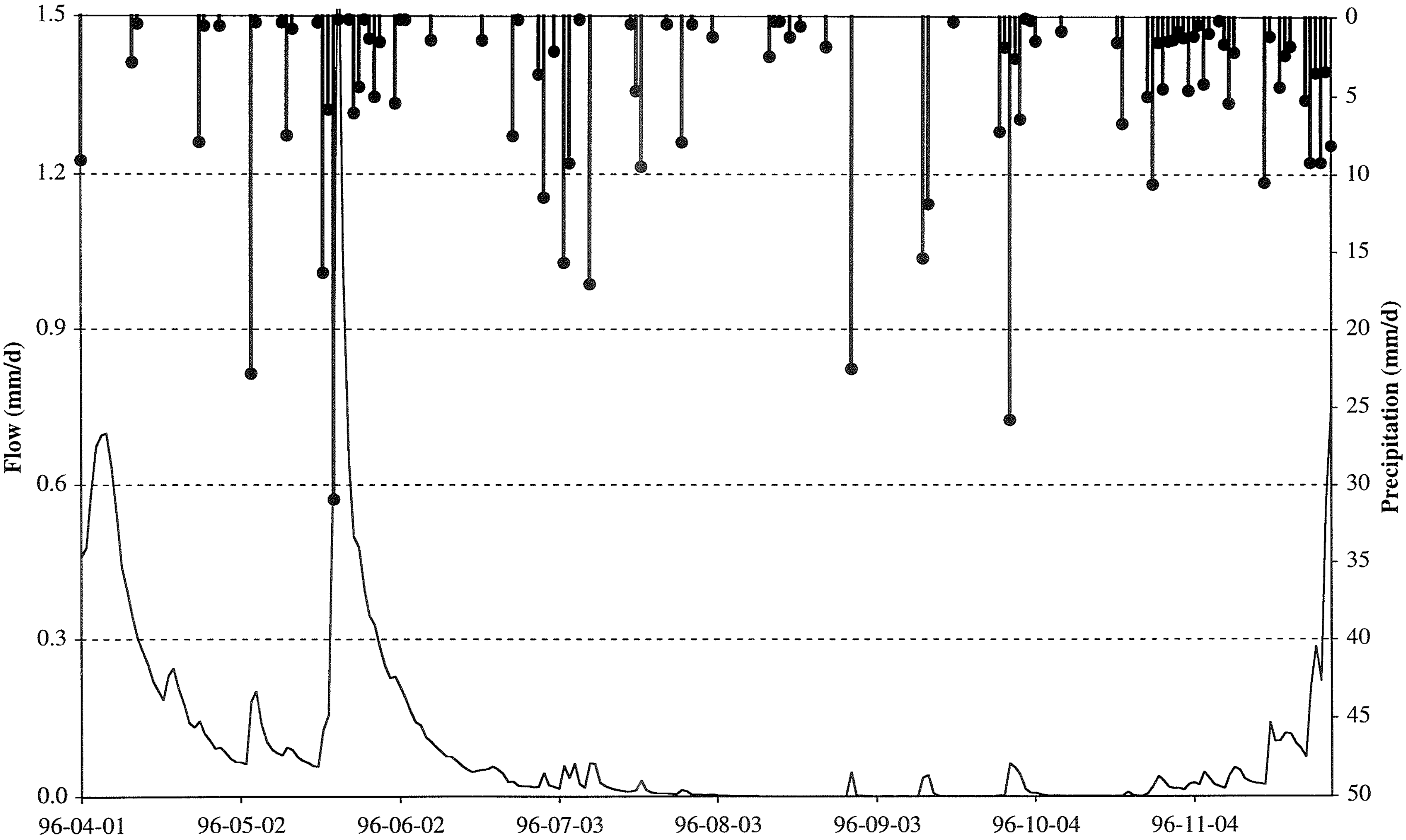

Figure 5. Waterflow measured at sampling site UT10 and precipitation measured in the area during April-November 1996.

Table 2. Crop distribution in the catchment area during 1990-1996

Crop	1990	1991	1992	1993	1994	1995	1996	Average
Fallow	1%					3%	2%	1%
Grass ley	2%	2%	2%	2%	1%	2%	1%	2%
Meadow		1%	1%	1%	2%	1%	1%	1%
Oats	2%	1%	4%	2%	5%	1%	1%	2%
Peas	6%	2%	1%			0%	1%	2%
Rye wheat		0%	1%	0%	1%	0%	2%	1%
Set aside land		0%	1%	1%	1%	1%	1%	1%
Spring barley	26%	27%	24%	15%	30%	22%	31%	25%
Spring rape	1%	0%			2%			0%
Spring wheat	5%	9%	1%	16%	12%	5%	3%	7%
Sugar beet	19%	11%	25%	23%	17%	21%	10%	18%
Winter barley			1%	2%	8%	5%	1%	2%
Winter rape	21%	22%	12%	19%	0%	27%	10%	16%
Winter rye	1%	0%	1%	2%	4%	1%	0%	1%
Winter wheat	16%	23%	25%	16%	18%	11%	36%	21%

The mean annual temperature in the area was 7.7°C 1995 and 6.8°C in 1996. The long-term (1961-1990) average value is 7.2°C. August and October were warmer and with less precipitation than normal, whereas May was colder and rainier than normal, during both years. The winter 1995/1996 was cold, with the ground covered with snow during extended periods.

Waterflow

Table 1 and **Figures 4 and 5** summarize flow data measured at the culvert outlet (site UT10) during the study period. The annual flow volumes were 152 mm and 66 mm in 1995 and 1996, respectively. The average annual flow volume is 262 mm based on 20 years of flow measurement data from a field site within the catchment (NA1). Flow volumes in 1995 and 1996 were obviously considerably less than the average, i.e. 57% and 25% of normal, respectively.

Agronomic practices and pesticide use

Crops

Table 2 summarize the crop data during 1990-1996. The four crops dominating within the catchment were spring barley, sugar beet, winter rape and winter wheat

(**Figure 6**), their total average percentage of the cultivated area being 80%. In 1995, winter rape was grown on 27% of the area, which is considerably more than the 1990-1996 average (16%). On the other hand, winter rape was grown on only 10% in 1996, since half of the winter rape area sown in the autumn 1995 out-wintered. In 1996, the sugar beet area was small, only 10%, and with cereals grown on 74% of the cultivated area. In 1995 cereals were grown on 45%, i.e. the smallest area since the start of the investigation (the average percentage is 60%).

Pesticide handling

Pesticides were handled, with spraying equipment being filled and rinsed, on 15 farms located within the catchment (13 of these situated upstream from sampling site UT10). None of the farms within the catchment had biobeds.

In 1996, 25% of the farmers operating in the catchment, spraying 50% of the cultivated area, used spraying equipment that had been through the officially organized voluntary inspection of field crop sprayers. This was the same area coverage as in 1990. The spraying equipment used by the farmers were on average 13 years old, with spraying nozzles generally being exchanged every second or third year.

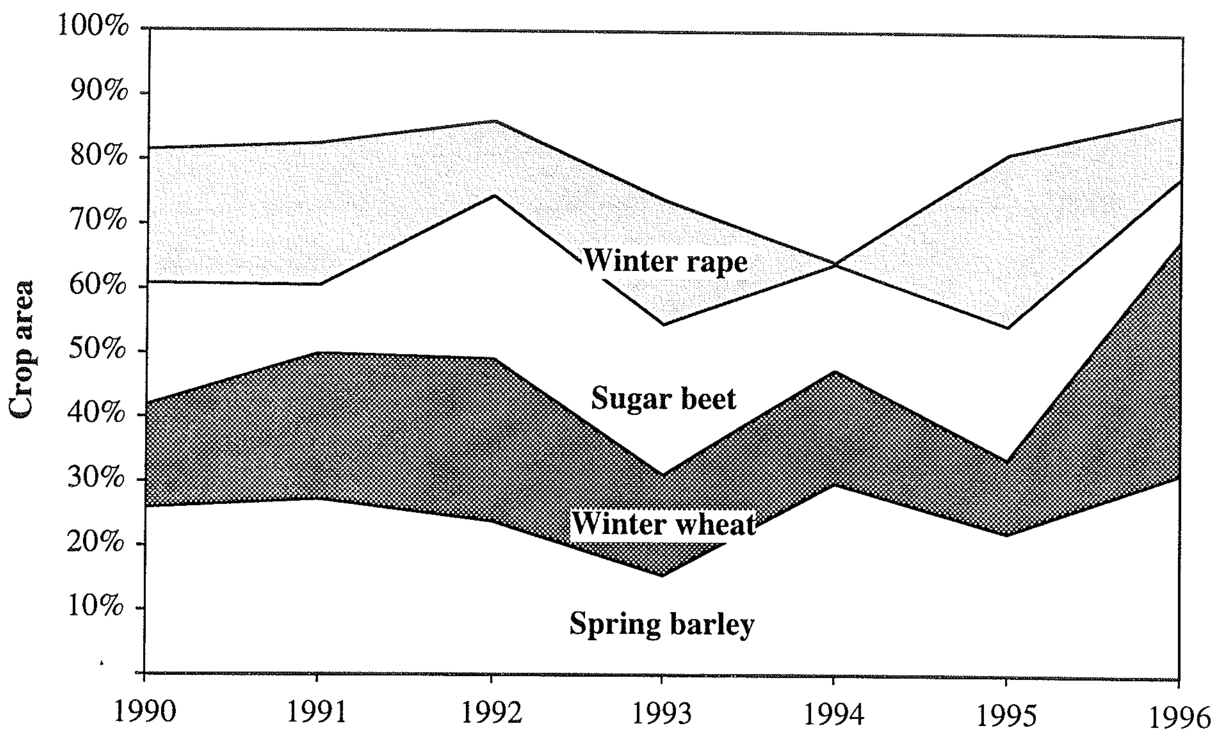

Figure 6. Crop area distribution during 1990-1996 for the main crops grown in the catchment area.

Pesticide usage

Courtyard application

Most farmers living within the catchment applied the herbicide glyphosate (in 'Roundup' and 'Avans') for weed control outside the field, mostly on courtyards, but also along roads and around field edges, poles and surface water inlet wells. Also herbicides not registered for use on courtyards, i.e. terbuthylazine (in 'Gardoprim' and 'Folar') and cyanazine (in 'Bladex'), as well as restricted herbicides, i.e. atrazine and dichlobenil (in 'Totex'), were occasionally used. The number of courtyards (located upstream from site UT10) treated with the different compounds were as follows: 'Roundup' or 'Avans' - 11 in 1995 and in 1996; 'Folar' - 2 in 1995 and 1 in 1996; 'Gardoprim' - 1 in 1995 and in 1996; 'Bladex' - 1 in 1995; 'Totex' - 1 in 1995 and in 1996. One farmer used the insecticide cyfluthrin (in 'Baytroid') on raspberries on one occasion during both years in the garden.

Field application

The use of pesticides within the catchment is extensive. Only one farmer, with 4 ha of land, did not use any type of pesticides. The total amount of pesticides applied within the catchment during each crop rotation in 1994/95-1995/96 was, on average, *ca.* 1200 kg active ingredient (AI), with *ca.* 40% applied in the autumn and *ca.* 60% during spring/early summer (**Figure 7**). This was a shift compared to previous years, when on average 80% of the pesticide application took place during spring/early summer.

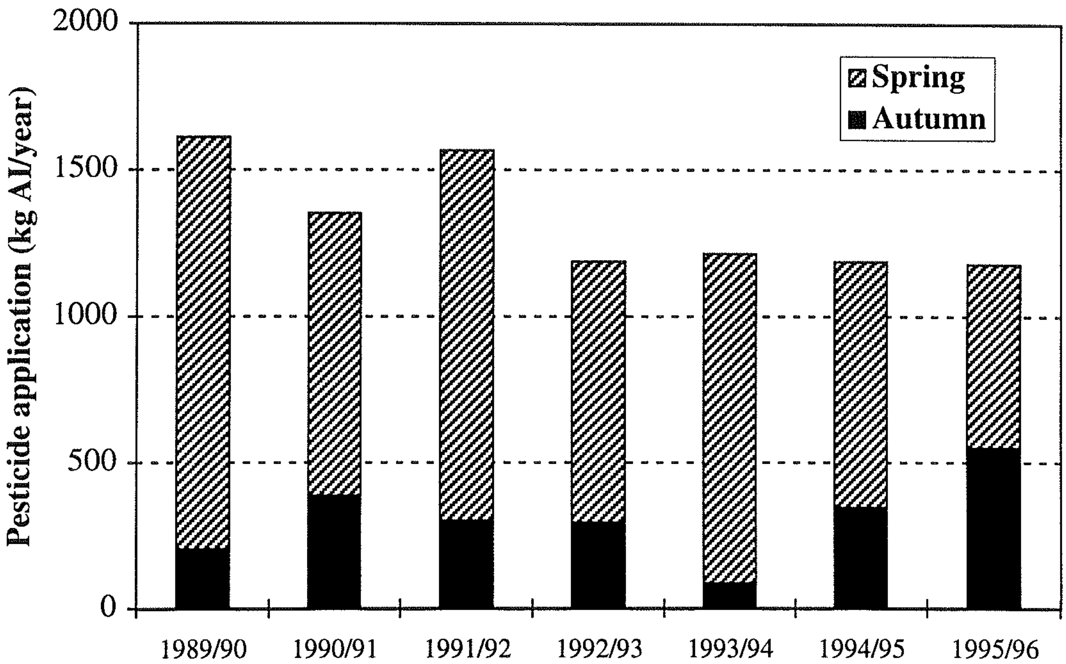

Figure 7. Total pesticide use in the catchment area during the growing seasons 1990-1996.

Table 3. Annually treated area (draining to UT10) and applied average rate

	Treated area (ha)			Dose (kg/ha)		
	1994	1995	1996	1994	1995	1996
Spring						
Herbicides	663	447	552	1.2	1.5	0.7
Fungicides	471	234	465	0.3	0.3	0.4
Insecticides	575	231	427	0.1	0.02	0.03
Growth regulators	45	4	3	0.7	1.4	0.8
Total	683	615	684	1.5	1.2	0.9
Autumn						
Herbicides	266	324	250	1.2	1.6	1.0
Fungicides	-	-	-	-	-	-
Insecticides	102	51	-	0.004	0.002	-
Growth regulators	-	-	-	-	-	-
Total	267	324	250	1.2	1.6	1.0

During the 1995/96 growing season, close to 50% of the amounts used were applied in the autumn. This had implications for the sampling strategies used, which has been directed to sampling during the summer months. The total amounts of pesticides used have not decreased during the past four years, but is lowered by 20% compared to the average amounts used during the first three growing seasons of the investigation (**Figure** 7).

Of the total area draining to sampling site UT10, on average, 79% (650 ha) was treated with pesticides during spring and early summer in 1995 and 1996 and 36% (296 ha) during the autumn in 1994 and 1995 (**Table 3**). The average applied herbicide rate during spring/early summer in 1996 (0.7 kg/ha) was the lowest since the start of the investigation, the corresponding figure for the first five years was 1.6 kg/ha. This was largely attributed to the small percentage of the area grown with sugar beet in 1996. Herbicide doses are generally considerably lager per hectare in sugar beets than in cereals. The area treated with fungicides and insecticides varies greatly between years as a result of different weather situations. In 1995, *ca.* 30% (*ca.* 230 ha) of the area was treated with fungicides and insecticides, compared to *ca.* 55% (*ca.* 450 ha) in 1996 (**Table 3**).

The pesticide usage during spring/early summer was dominated by herbicide applications (77%), with the remainder made up of fungicides (21%), insecticides (2%) and growth regulators (<1%), although there were large variations between the years (**Table 4 and 5**). Autumn application was completely dominated by herbicides (100%). During the two year period, 32 different AI's were applied on fields within the catchment; the average annual use of different AI's was 29. Ten of these AI's accounting for almost 90% of total weight applied.

Table 4. Seasonal amounts of filed applied pesticides in the catchment

LU12 Substance	Type *	autumn 1994 kg	spring 1995 kg	autumn 1995 kg	spring 1996 kg	autumn 1996 kg
aclonifen#	H				0.9	
bentazone	H				8.6	
bromoxynil#	H	0.4	2.9		1.3	
carbendazim#	*F*				1.7	
chloridazon	H		77.7		9.7	
chlormequat chloride#	g		5.6		2.4	
clopyralid	H		0.2		1.7	
cycloxydim#	H	26.8		14.1	2.7	
cyfluthrin	I	0.02	0.3		0.7	
deltamethrin	I				0.4	
dichlorprop-P	H	2.0	13.2		30.4	
diflufenican°	H	4.7		23.3		20.4
esfenvalerate	I		0.6		2.7	
ethofumesate	H		34.5		15.8	
fenpropimorph	*F*		55.5		149.8	
fluroxypyr°	H		7.6		22.1	
glyphosate#	H	27.5	22.2	16.9	0.7	49.0
ioxynil#	H	0.6	4.3		1.9	
isoproturon	H	51.8	21.9	233.9	0.3	210.2
lambda-cyhalothrin	I	0.4	1.1	0.1	1.7	
MCPA	H	1.4	41.8		87.7	
mecoprop-P	H	4.2	93.8	69.7	38.1	
metamitron	H		355.1		147.4	
metazachlor	H	224.5		143.5		25.1
methabenzthiazuron	H		3.9			
phenmedipham	H		68.2		29.4	
pirimicarb	I		2.7		10.5	
propiconazole	*F*		18.5		52.1	
prosulfocarb°	H			40.8		
sethoxydim#	H	1.7	6.6	8.5		
triadimenol	*F*				0.7	
tribenuron-methyl°	H		2.1		3.8	
Total amount		**346.0**	**840.3**	**550.8**	**625.2**	**304.7**

Herbicides	345.6	756.0	550.7	402.6	304.7
Fungicides		74.0		204.3	
Insecticides	0.4	4.7	0.1	16.0	
Growth regulators		5.6		2.4	

Herbicides	100%	90%	100%	64%	100%
Fungicides		9%		33%	
Insecticides	0%	1%	0%	3%	
Growth regulators		1%		0%	

= Pesticide not included in the analysis during 1995-1996.
° = Pesticide only included in the analysis of some samples.
* H=Herbicide; F=Fungicide; I=Insecticide; g=Growth regulator.

Table 5. Seasonal amounts of field applied pesticides in the area draining to site UT10

UT10 **Substance**	**Type** *****	**autumn 1994 kg**	**spring 1995 kg**	**autumn 1995 kg**	**spring 1996 kg**	**autumn 1996 kg**
aclonifen#	H				0.9	
bentazone	H				8.6	
bromoxynil#	H	0.4	2.9		1.0	
carbendazim#	*F*				1.7	
chloridazon	H		59.2		8.7	
chlormequat chloride#	g		5.6		2.4	
clopyralid	H		0.2		0.8	
cycloxydim#	H	25.9		14.1	2.7	
cyfluthrin	**I**	0.02	0.3		0.5	
deltamethrin	**I**				0.4	
dichlorprop-P	H	2.0	13.2		29.4	
diflufenican°	H	4.7		22.6		17.4
esfenvalerate	**I**		0.6		2.6	
ethofumesate	H		32.7		15.3	
fenpropimorph	*F*		52.3		142.4	
fluroxypyr°	H		5.9		20.3	
glyphosate#	H	23.3	20.6	12.1	0.7	45.2
ioxynil#	H	0.6	4.3		1.6	
isoproturon	H	51.8	21.9	219.8		185.3
lambda-cyhalothrin	**I**	0.4	1.1	0.1	1.7	
MCPA	H	1.4	28.4		79.0	
mecoprop-P	H	4.2	91.3	69.7	32.3	
metamitron	H		317.1		142.6	
metazachlor	H	211.7		126.9		13.0
methabenzthiazuron	H		3.9			
phenmedipham	H		62.5		28.4	
pirimicarb	**I**		2.6		9.4	
propiconazole	*F*		17.4		49.6	
prosulfocarb°	H			40.8		
sethoxydim#	H	1.7	6.6	8.5		
triadimenol	*F*				0.7	
tribenuron-methyl°	H		2.0		3.7	
Total amount		**328.1**	**752.6**	**514.6**	**587.2**	**260.9**

Herbicides	327.7	672.7	514.5	375.9	260.9
Fungicides		69.7		194.4	
Insecticides	0.4	4.6	0.1	14.5	
Growth regulators		5.6		2.4	

Herbicides	100%	89%	100%	64%	100%
Fungicides		9%		33%	
Insecticides	0%	1%	0%	2%	
Growth regulators		1%		0%	

= Pesticide not included in the analysis during 1995-1996.

° = Pesticide only included in the analysis of some samples.

* H=Herbicide; F=Fungicide; I=Insecticide; g=Growth regulator.

Eight of the 32 pesticides used in the catchment were not included in the analyses and another four pesticides were only included during limited time periods (**Table 4**). Pesticides not included represented *ca.* 11% of the total amount applied, which is an increase compared to recent years.

The main application season during autumn stretches from the end of August to mid-October and during spring from the beginning of April to early July. On average, *ca.* 60% of the total amount used each spring/early summer is applied in May. In 1996, following a long and cold winter, the application season started in mid-April, which is later than normal. About *ca.* 60% of the pesticide amount was applied in June this year (**Figure 8**). Due to late insect control in sugar beets the application season was extended to the end of July. In spring 1995, the largest amounts were applied during May. A compilation of amounts used, area treated, doses and application period during 1995-1996 (including autumn 1994) for each pesticide is given in **Appendices 1-5**. Trade names of the commercial products used in the catchment and the included active ingredients are given in **Appendix 6.**

The total amount of pesticides used within agriculture in Sweden decreased by almost 50% during a 6-year period, from 2343 tons in 1990 to 1224 tons in 1995 (Kvist, 1996). The corresponding figure for the catchment is a decrease by 22%, from 1.8 tons in 1990 to 1.4 tons in 1995. In **Figure 9** the use of herbicides, fungicides and insecticides in Sweden, and in the catchment, since the start of the investigation in 1990 are compared (information on pesticide use in Sweden as a whole in 1996 was not accessible before finalizing this report). Pesticide usage in the catchment corresponded to *ca.* 0.1% of the total amount used within agriculture in Sweden.

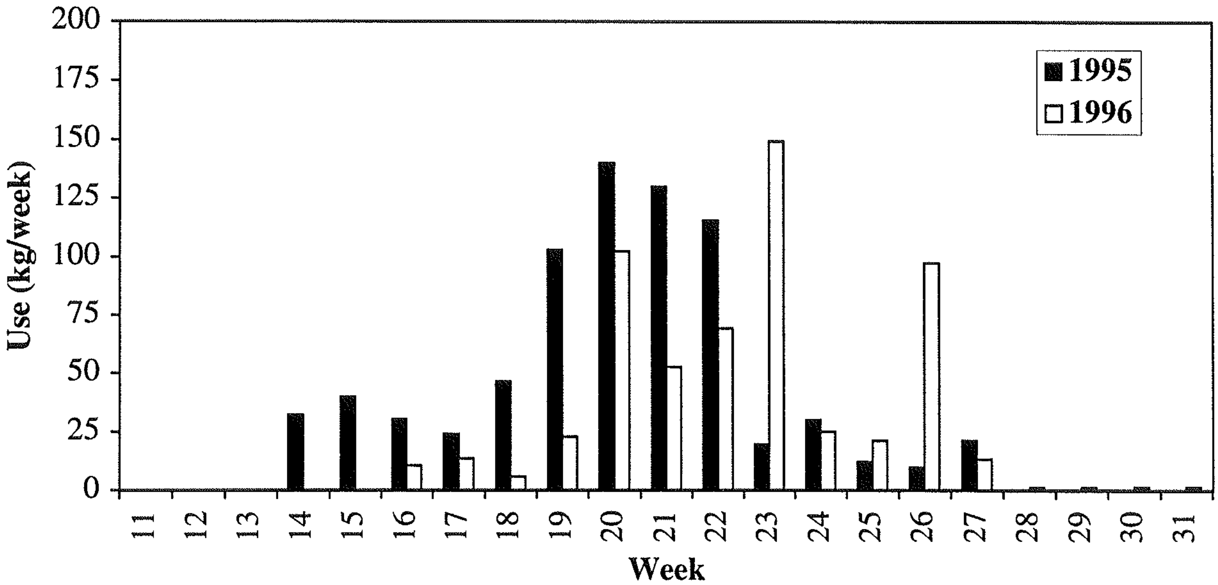

Figure 8. Temporal distribution of spring/early summer application of pesticides in the catchment.

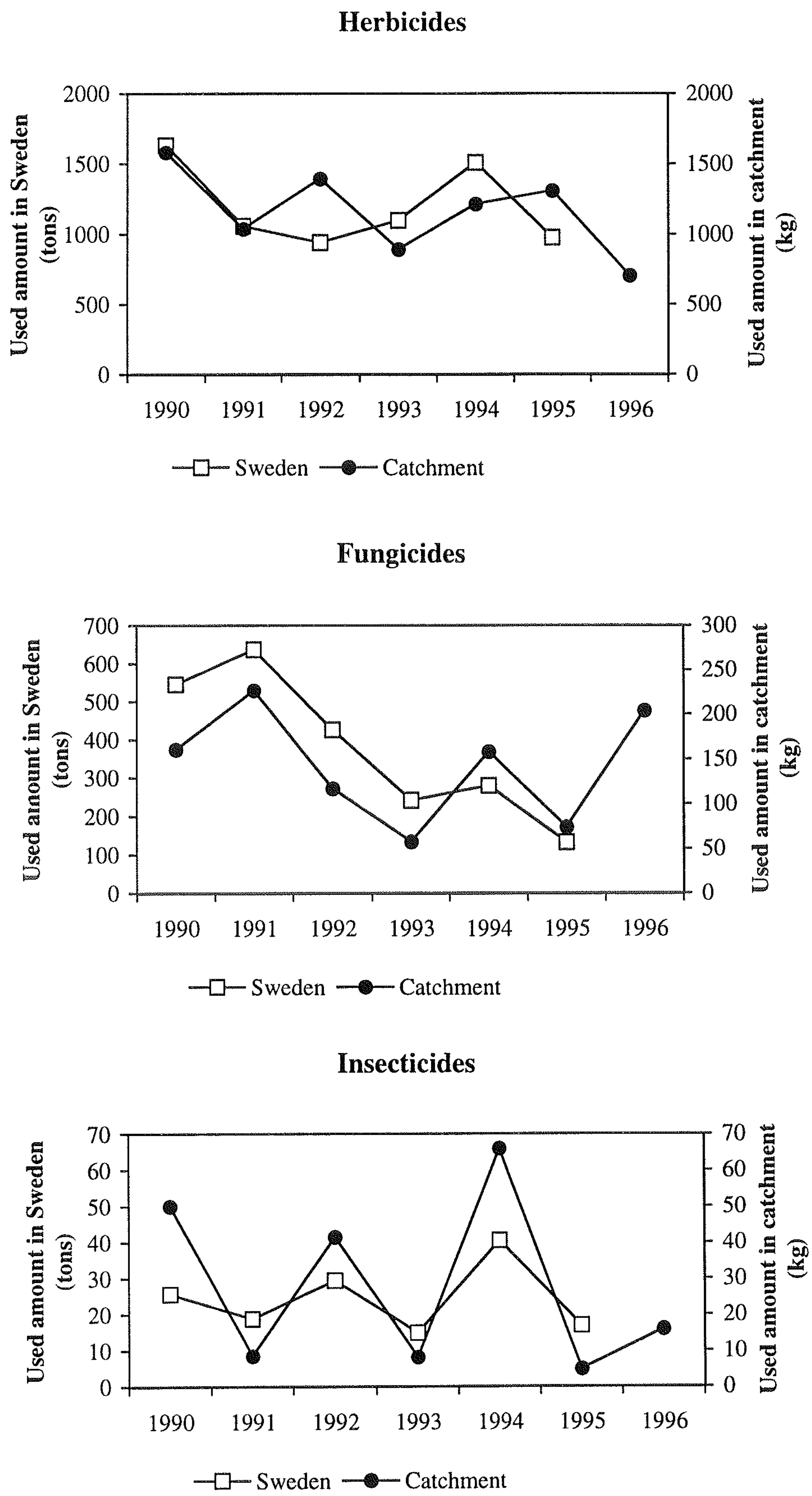

Figure 9. The use of herbicides, fungicides and insecticides in Sweden as a whole and in the catchment 1990-1996.

Pesticide findings in water

Concentrations

During the 1995-1996 investigation period a total of 44 water samples were collected at the culvert discharge (site UT10) during May-November. All samples, but the first sample each year, were time-paced composite samples. A complete record of the analytical results is given in **Appendix 7** (values within parenthesis in the appendix have been confirmed, but are below the stipulated limits of determination and are therefore not quantified with the normal precision). As a result of the general nature of the multiresidue analysis, *ca.* 80 pesticides were analyzed with the two analytical methods used. However, only pesticides used within the catchment during 1995-1996, or those detected in water samples during previous years, were included in the tables of this report.

The results from each year are statistically summarized in **Table 6**. Altogether, 27 pesticides, distributed among 21 herbicides, 2 fungicides, 3 insecticides and 1 metabolite, were identified. Most frequently detected pesticides during the two-year period were terbuthylazine (100% detection frequency), diflufenican (100%, only analyzed from July 1996), metazachlor (91%), mecoprop (89%), atrazine (80%), ethofumesate (73%), propiconazole (70%), isoproturon (68%) and bentazone (68%).

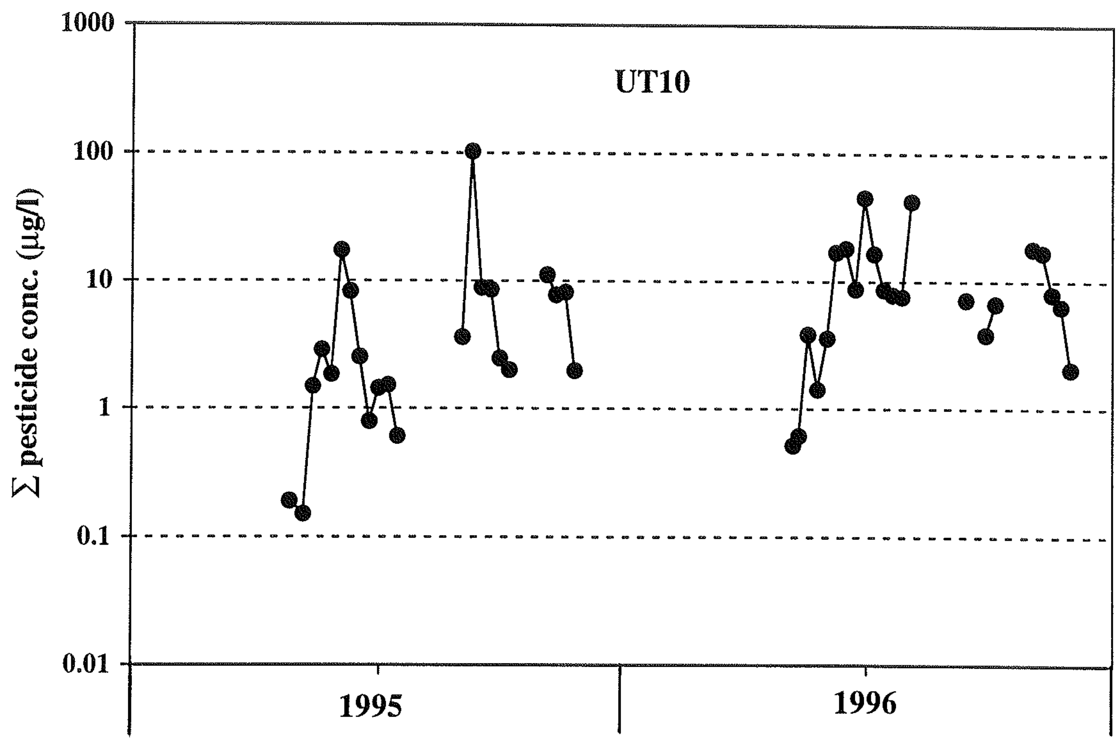

Figure 10. Total pesticide concentration in time paced composite samples collected at UT10 during May-November in 1995 and 1996.

Table 6. Results of pesticide analysis of water samples collected at site UT10 during May-November 1995 and 1996

ISCO UT10	**1995**						**1996**					
Substance	LOD	No	Det	Freq	TWMC	Max	LOD	No	Det	Freq	TWMC	Max
atrazine	0.1	22	15	68%	0.06	0.2	0.1	22	20	91%	0.24	0.9
atrazine-desethyl	0.2-0.3	22	0	0%			0.2-0.3	22	2	9%	0.01	0.1
BAM	0.1	22	0	0%			0.1-0.2	22	0	0%		
benazolin-ethylester	0.1	22	2	9%	0.02	0.4	0.1	22	0	0%		
bentazone	0.1	22	13	59%	0.15	0.5	0.1-0.3	22	17	77%	0.20	1
chloridazon	0.5	22	2	9%	0.04	0.6	0.1-0.6	22	2	9%	0.04	0.6
clopyralid	0.3	22	0	0%			0.1-0.7	22	0	0%		
cyanazine	0.1	22	10	45%	0.04	0.2	0.1	22	1	5%	0.02	0.4
cyfluthrin	0.2	22	0	0%			0.2	22	2	9%	0.15	5
2,4-D	0.1	22	0	0%			0.1-0.2	22	2	9%	0.01	0.1
deltamethrin	0.1	22	0	0%			0.1	22	0	0%		
dichlobenil	0.1	22	0	0%			0.1	22	0	0%		
dichlorprop	0.1	22	3	14%	0.01	0.2	0.1	22	14	64%	1.91	20
diflufenican	n.a.						0.1	13	13	100%	0.13	0.3
dimethoate	0.1	22	0	0%			0.1	22	1	5%	0.48	30
diuron	0.1-0.3	22	0	0%			0.1-0.5	22	4	18%	0.04	0.2
esfenvalerate	0.1	22	0	0%			0.1	22	0	0%		
ethofumesate	0.1	22	17	77%	0.14	0.9	0.1	22	15	68%	0.10	0.2
fenpropimorph	0.1	22	9	41%	0.06	0.6	0.1	22	16	73%	0.17	0.7
flamprop-M	0.1-0.2	8	0	0%			0.1-0.2	19	0	0%		
fluroxypyr	0.2-0.3	8	0	0%			0.2-0.5	22	14	64%	0.63	5
hexazinon	0.1	22	3	14%	0.01	0.09	0.1-0.2	22	0	0%		
isoproturon	0.2	22	8	36%	0.75	5	0.1-0.2	22	22	100%	1.72	10
lambda-cyhalothrin	0.1	22	0	0%			0.1	22	0	0%		
linuron	0.2-0.5	22	0	0%			0.1-0.5	22	0	0%		
MCPA	0.1	22	5	23%	0.06	0.9	0.1	22	13	59%	0.63	5
mecoprop	0.1	22	21	95%	0.88	8	0.1	22	18	82%	1.02	8
metamitron	0.5	22	5	23%	0.50	6	0.2-0.5	22	3	14%	0.09	1
metazachlor	0.1-0.2	22	22	100%	4.48	100	0.1-0.2	22	18	82%	0.22	0.5
methabenzthiazuron	0.2-0.5	22	0	0%			0.2-0.5	22	0	0%		
phenmedipham	1	22	0	0%			1	22	0	0%		
pirimicarb	0.1	22	5	23%	0.02	0.1	0.1	22	10	45%	0.11	0.7
prochloraz	0.2-0.5	22	0	0%			0.2-0.5	22	0	0%		
propiconazole	0.1-0.2	22	12	55%	0.14	1	0.1-0.2	22	19	86%	0.59	2
propyzamide	0.1	22	0	0%			0.1	22	0	0%		
prosulfocarb	n.a.						0.2	13	4	31%	0.17	0.8
simazine	0.1	22	4	18%	0.01	0.1	0.1	22	10	45%	0.08	0.3
terbuthylazine	0.1	22	22	100%	0.91	4	0.1	22	22	100%	1.97	6
triadimenol	0.2	22	0	0%			0.2-0.4	22	0	0%		
tribenuron-methyl	0.005	3	1	33%		0.01	n.a.					
Sum pest		22	22	100%	8.29	104		22	22	100%	10.61	45.6

LOD = Limit of determination (µg/l); No = Number of samples analysed; Det = Number of detections
Freq = Detection frequency; TWMC = Time Weighted Mean Concentration during sampling period (µg/l)
Max = Maximum concentration detected (µg/l)

Concentrations of pesticides in culvert discharge were observed throughout the sampling periods (**Figure 10**). Total pesticide concentration in samples from 1995-1996 were, however, generally lower than those detected in earlier samples from site UT10. The average total pesticide concentration in 1995 and in 1996 were *ca.* 10 µg/l (**Table 6**), which was three times lower than the average total concentration during the previous three years in samples from the same site (*ca.* 30 µg/l). Time-weighted mean concentrations (TWMC) for each month is given in **Appendix 8**. Monthly total pesticide TWMC varied between 1.1 and 29.3 µg/l.

Pesticides applied in the autumn were still detected in water samples collected the following spring. Metazachlor, only applied during the autumns, was present at 0.05-0.5 µg/l in all water samples collected during both years from the start of the sampling season in early May till the spraying season started in August. Also isoproturon in 1996, prevailed in water samples at 0.07-0.4 µg/l through the summer period, despite no spring application. When application with metazachlor and isoproturon started in the autumn, concentrations increased markedly in the water samples. Water sampling has only been carried out during one winter season (in 1992/93), during which both metazachlor and isoproturon were detected in culvert discharge during extended periods (Kreuger, 1996).

Diflufenican was first used in the catchment during autumn 1994 (in a spraymixture with isoproturon, 'Cougar'), but was not included in the analyses until July 1996. It was then detected in water samples at 0.08-0.1 µg/l despite no application since the previous autumn. Also mecoprop and bentazone were detected at low concentrations in water samples in 1996, prior to spring application.

In **Figures 11-24** the response of pesticide concentration to waterflow changes, during sampling periods May-November each year, are presented for some of the most frequently detected pesticides. Note the different scale on the concentration axes in different figures.

No bromide was detected in culvert discharge during an eight week period following the application on the courtyard in May 1995, despite some heavy rainfall during this time. No traces of pesticides were detected in the blank sample stored in the automatic water sampler in June 1996.

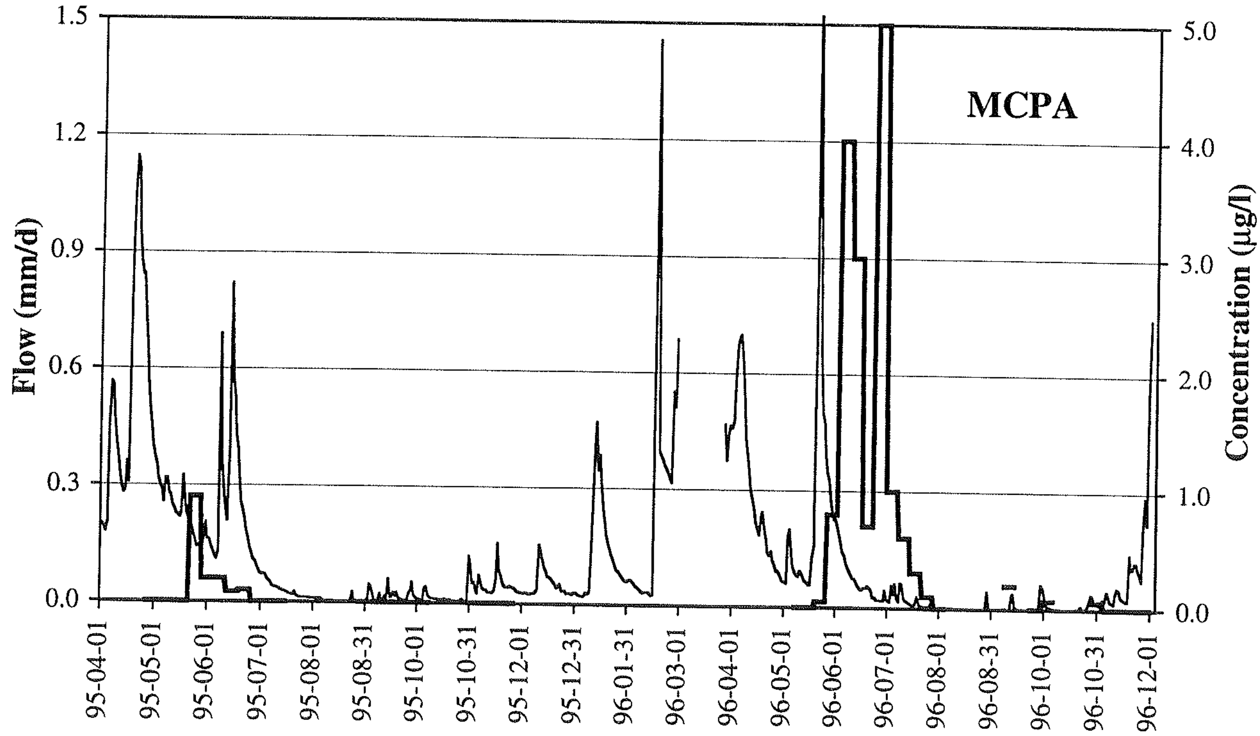

Figure 11. Waterflow and concentration of MCPA (bold line) at site UT10 in 1995 and 1996.

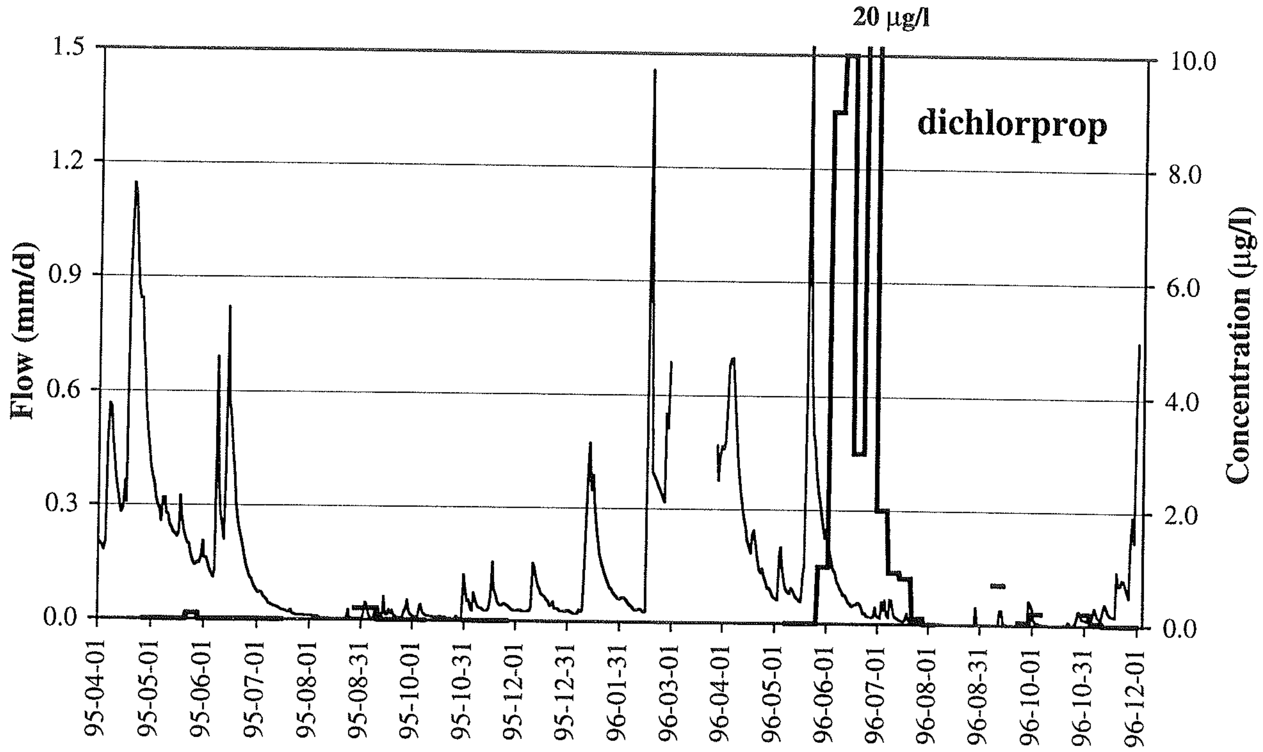

Figure 12. Waterflow and concentration of dichlorprop (bold line) at site UT10 in 1995 and 1996.

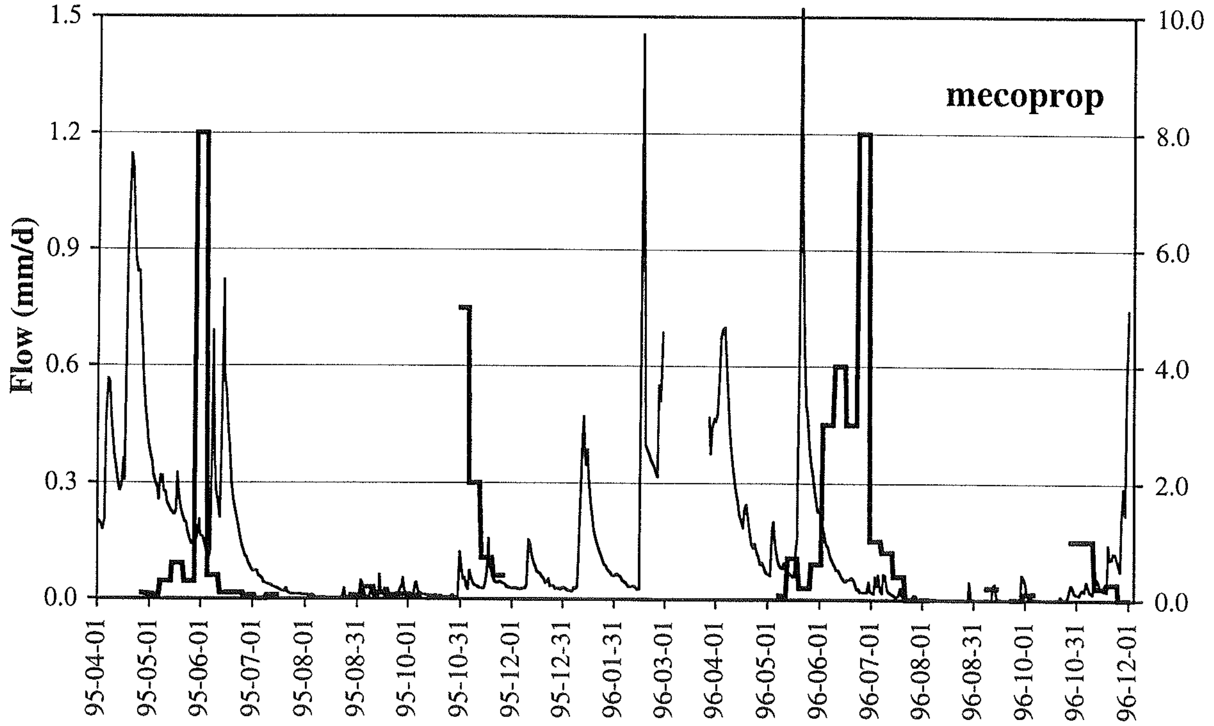

Figure 13. Waterflow and concentration of mecoprop (bold line) at site UT10 in 1995 and 1996.

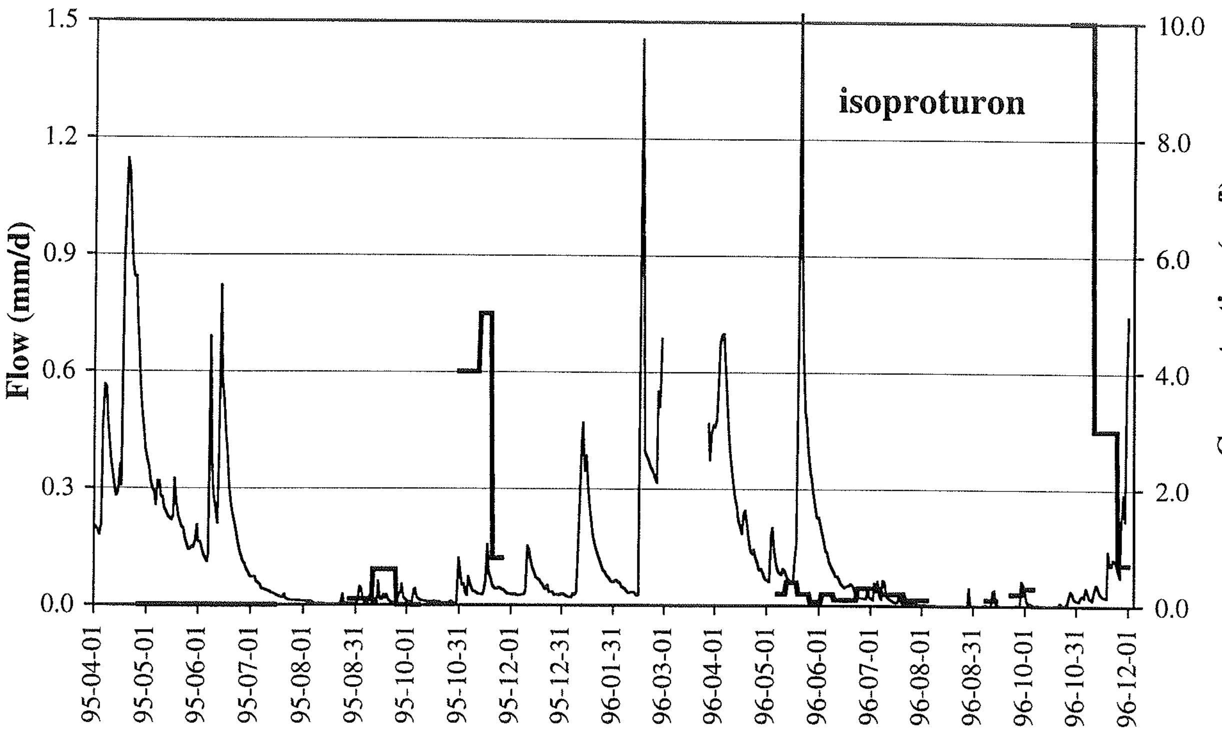

Figure 14. Waterflow and concentration of isoproturon (bold line) at site UT10 in 1995 and 1996.

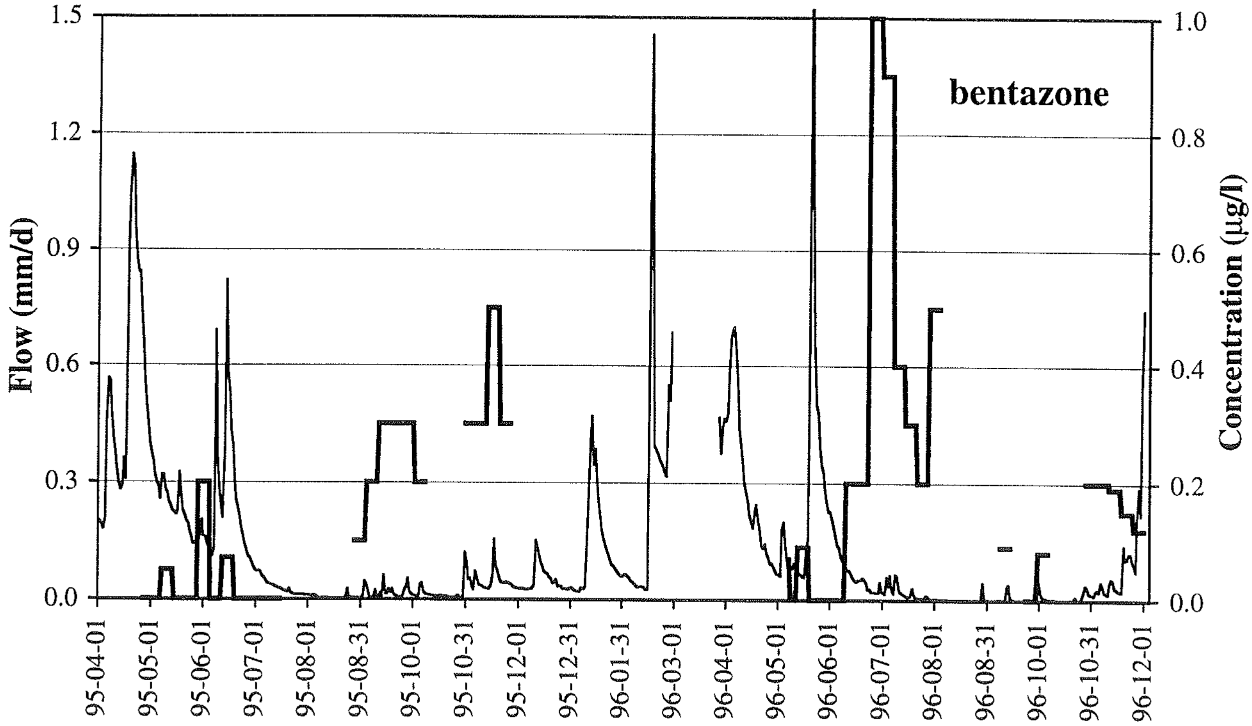

Figure 15. Waterflow and concentration of bentazone (bold line) at site UT10 in 1995 and 1996.

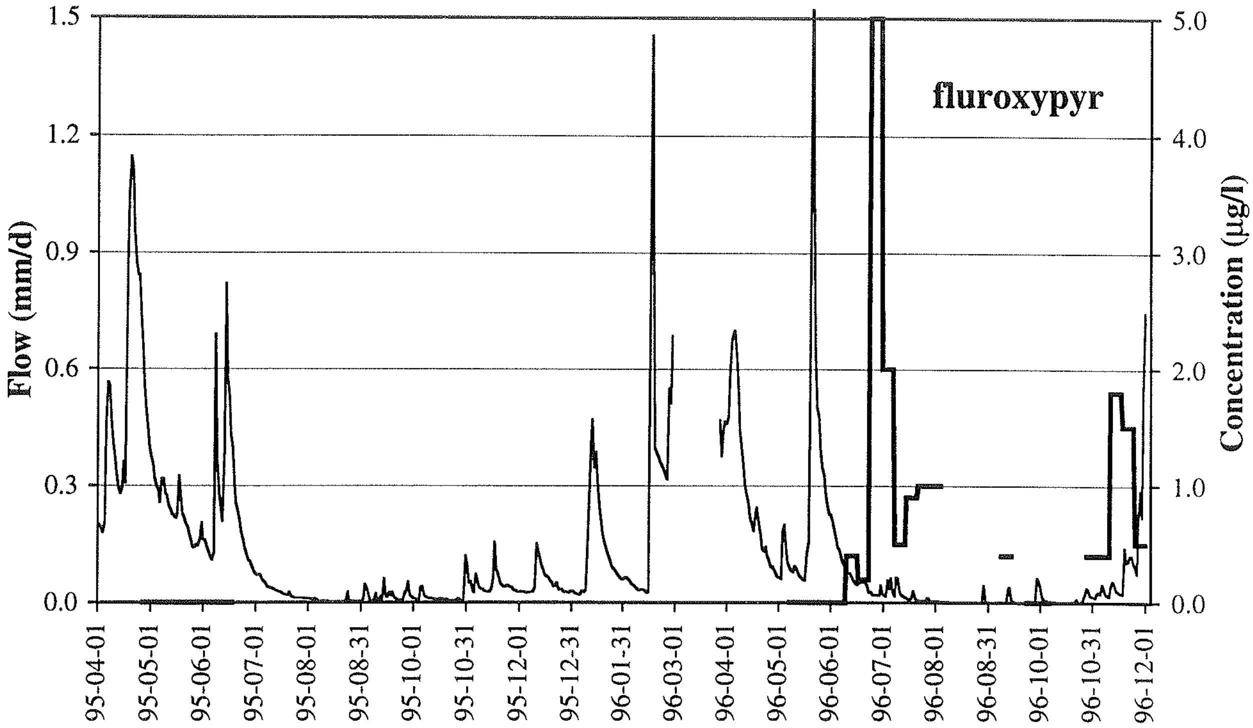

Figure 16. Waterflow and concentration of fluroxypyr (bold line) at site UT10 in 1995 and 1996.

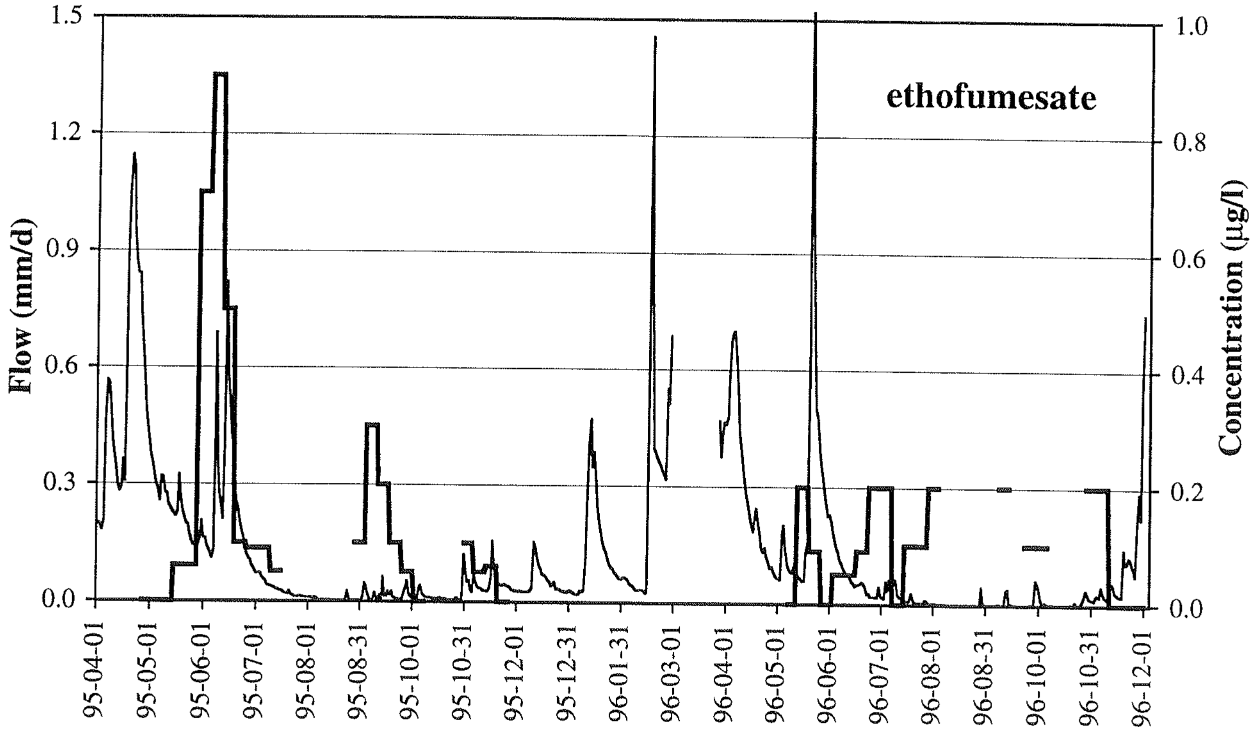

Figure 17. Waterflow and concentration of ethofumesate (bold line) at UT10 in 1995 and 1996.

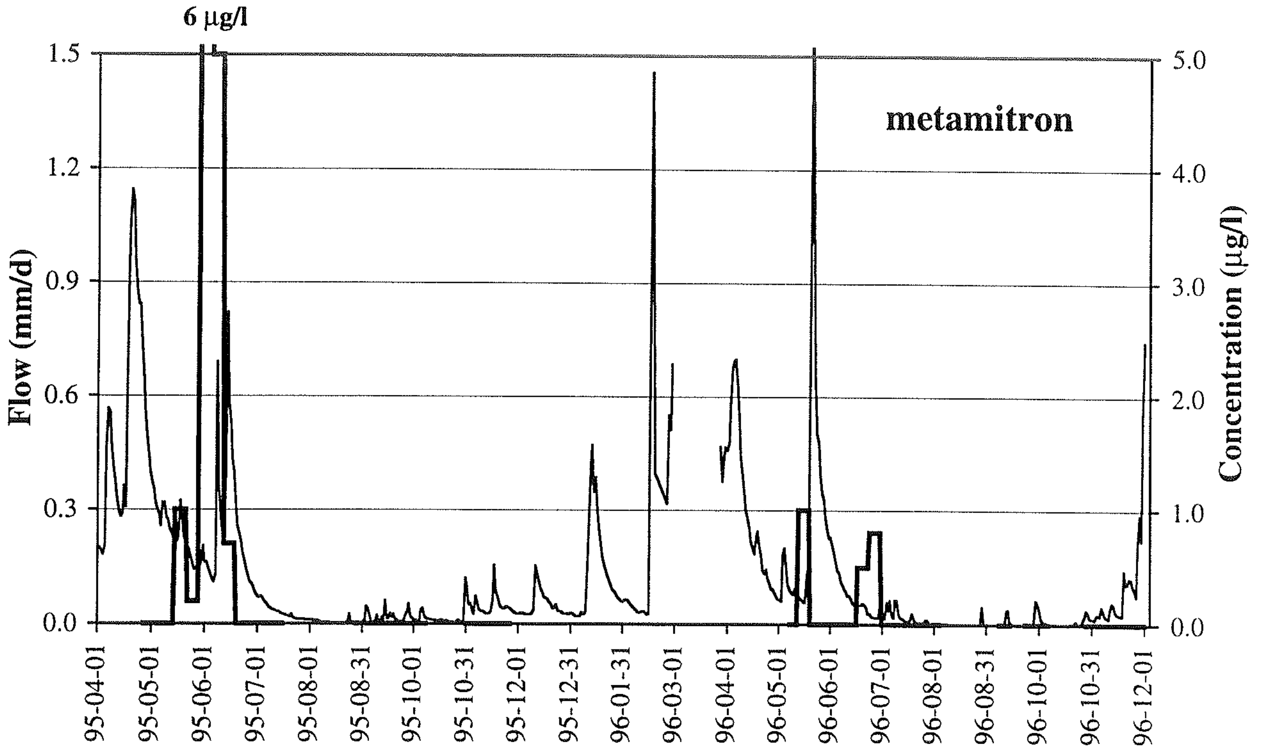

Figure 18. Waterflow and concentration of metamitron (bold line) at site UT10 in 1995 and 1996.

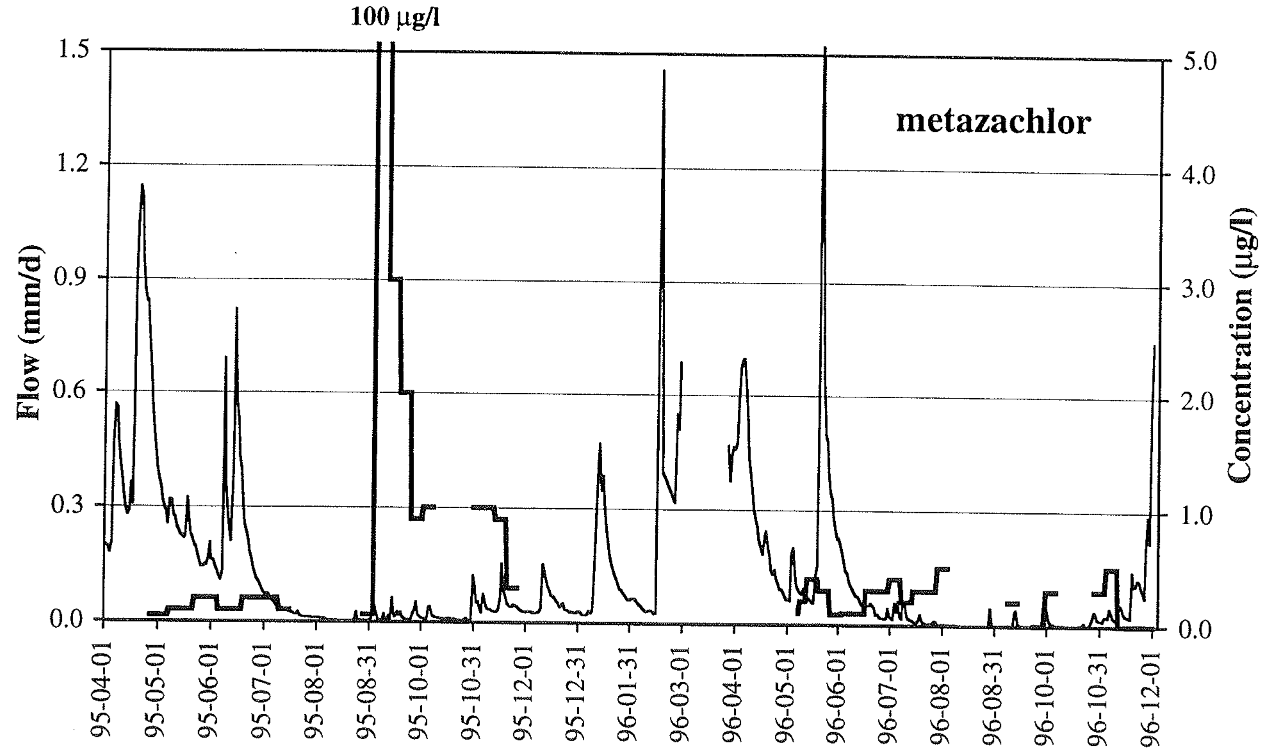

Figure 19. Waterflow and concentration of metazachlor (bold line) at site UT10 in 1995 and 1996.

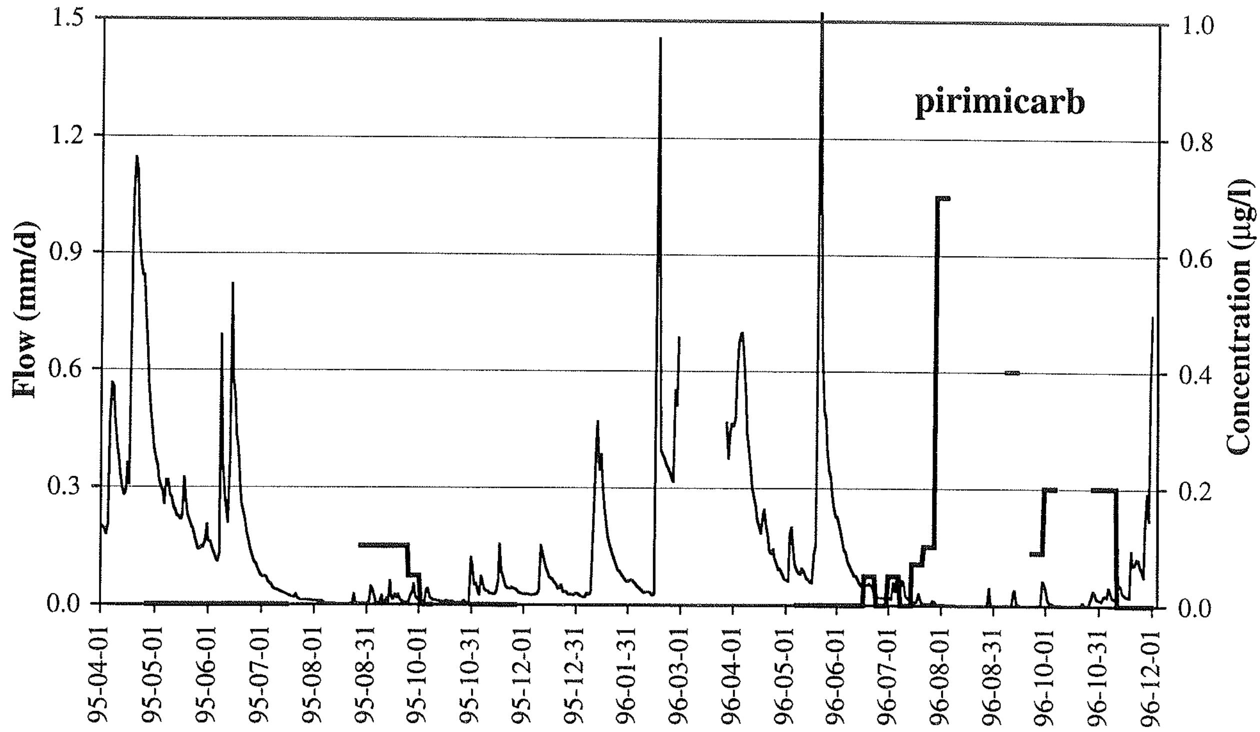

Figure 20. Waterflow and concentration of pirimicarb (bold line) at site UT10 in 1995 and 1996.

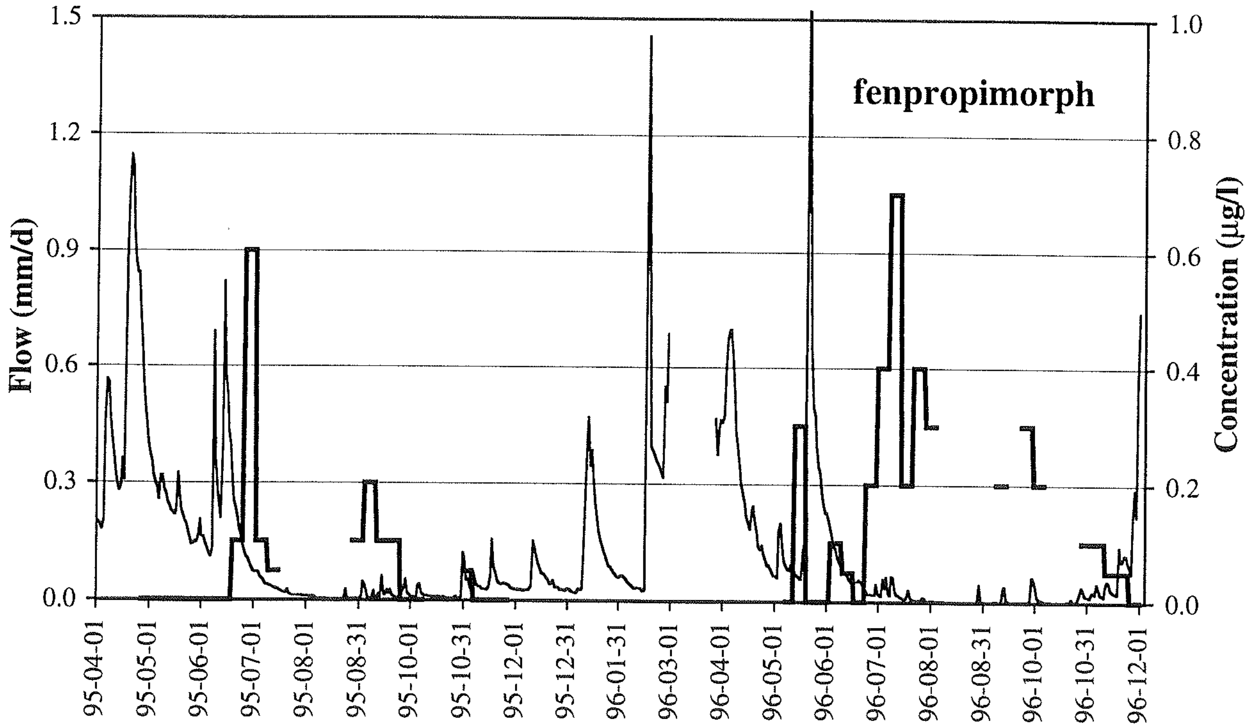

Figure 21. Waterflow and concentration of fenpropimorph (bold line) at UT10 in 1995 and 1996.

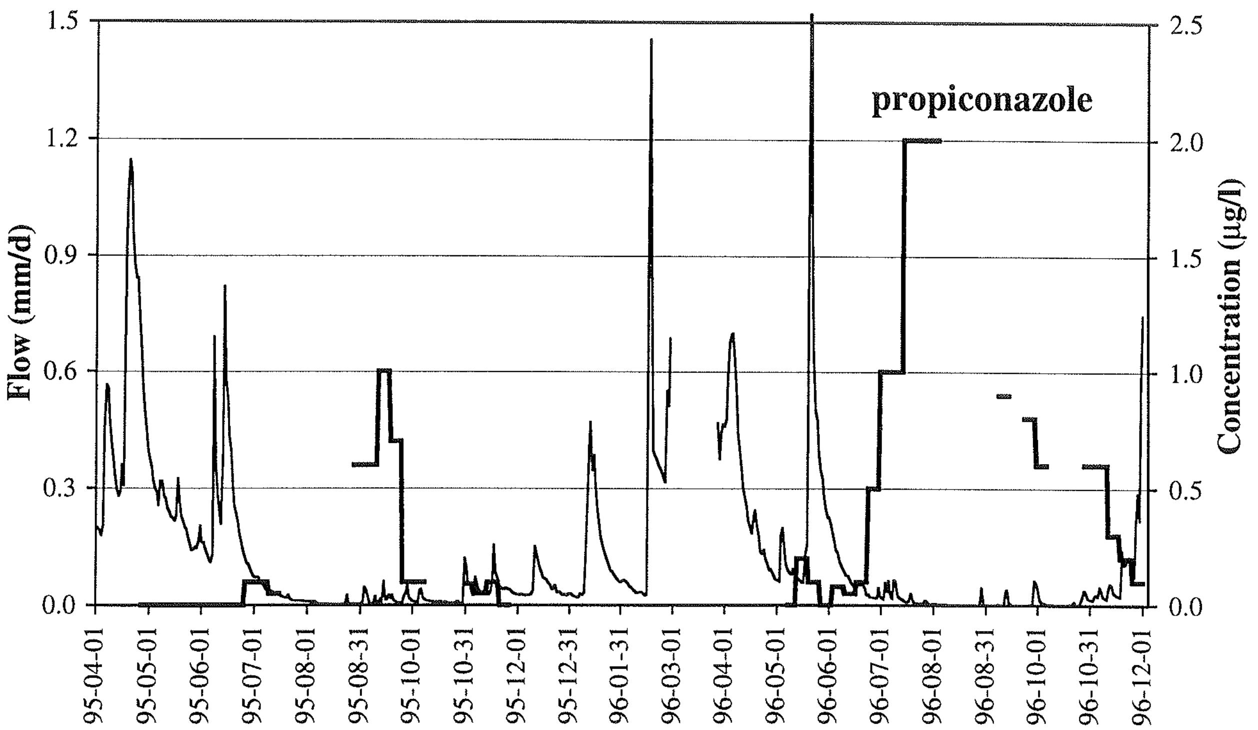

Figure 22. Waterflow and concentration of propiconazole (bold line) at UT10 in 1995 and 1996.

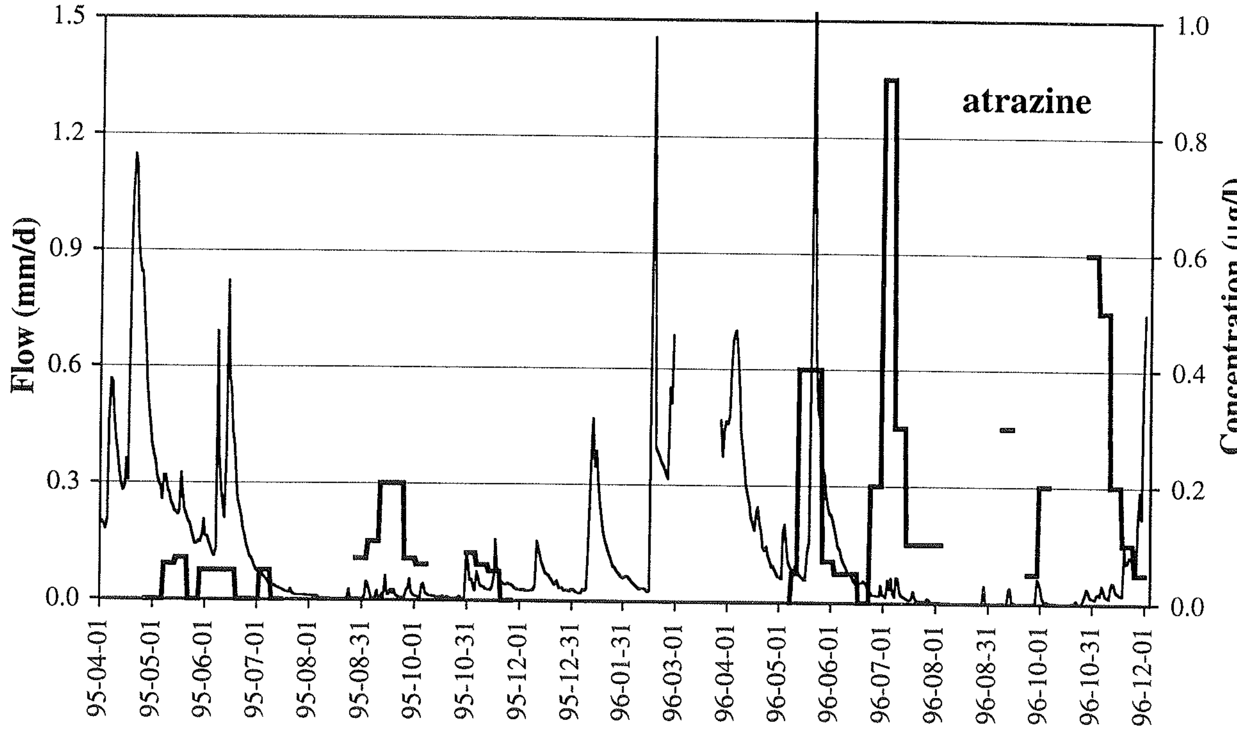

Figure 23. Waterflow and concentration of atrazine (bold line) at site UT10 in 1995 and 1996.

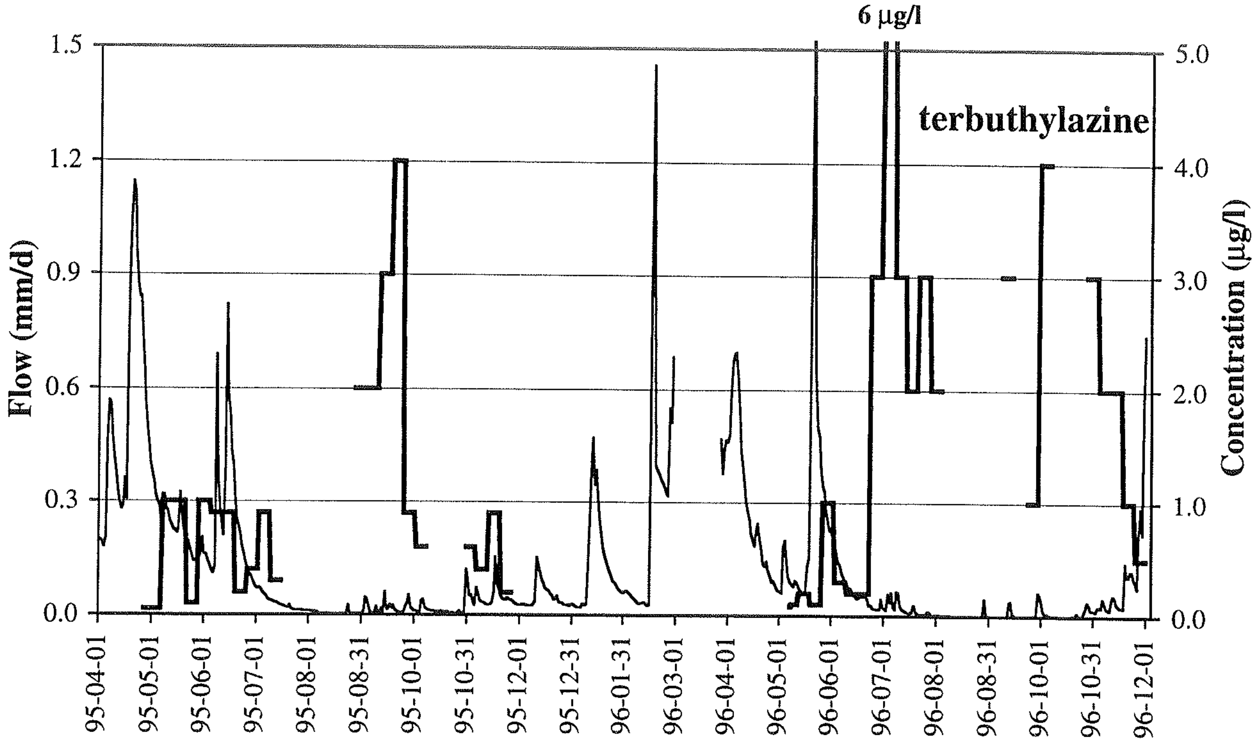

Figure 24. Waterflow and concentration of terbuthylazine (bold line) at UT10 in 1995 and 1996.

Table 7. Losses of spring applied pesticides in water at site UT10

Substance	1995 May-Sep	1995 May-Nov	1996 May-Sep	1996 May-Nov	Average loss 95-96 May-Sep	Average loss 95-96 May-Nov	Av. loss 92-94 May-Sep
bentazone	n.u.		0.08%	0.12%	0.08%	0.12%	0.16%
chloridazon	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.28%
clopyralid	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.05%
cyfluthrin	0.00%	0.00%	0.26%	0.26%	0.13%	0.13%	0.27%
deltamethrin	n.u.		0.00%	0.00%	0.00%	0.00%	0.00%
dichlorprop	0.01%	0.01%	0.56%	0.57%	0.29%	0.29%	0.16%
esfenvalerate	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%
ethofumesate	0.12%	0.12%	0.04%	0.05%	0.08%	0.09%	0.11%
fenpropimorph	0.01%	0.01%	0.00%	0.00%	0.01%	0.01%	0.02%
fluroxypyr	n.a.		0.08%	0.19%	0.08%	0.19%	0.05%
isoproturon	0.01%	a.a.	n.u.		0.01%		0.02%
lambda-cyhalotrin	0.00%	a.a.	0.00%	0.00%	0.00%	0.00%	0.00%
MCPA	0.06%	0.06%	0.09%	0.09%	0.07%	0.07%	0.11%
mecoprop	0.11%	a.a.	0.26%	0.28%	0.19%	0.28%	0.10%
metamitron	0.05%	0.05%	0.01%	0.01%	0.03%	0.03%	0.07%
methabenzthiazuron	0.00%	0.00%	n.u.		0.00%	0.00%	0.06%
phenmedipham	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
pirimicarb	0.01%	0.01%	0.01%	0.02%	0.01%	0.02%	0.07%
propiconazole	0.02%	0.03%	0.03%	0.04%	0.02%	0.03%	0.08%
triadimenol	n.u.		0.00%	0.00%	0.00%	0.00%	0.00%
Av. all pesticides	0.03%	0.02%	0.08%	0.09%	0.05%	0.07%	0.07%

n.u. = not used; n.a. = not analysed; a.a. = autumn application

Transport and loss

Calculated monthly transported quantities and total seasonal losses of each pesticide during 1995-1996 are presented in **Appendix 9**. Losses for single pesticides were generally less than 0.1% of the applied amount during individual years; the average loss during May-September was 0.03% in 1995 and 0.08% in 1996 (**Table 7**). These losses were comparable with those registered previously. The average loss of single pesticides at the same site during May-September 1992-1994 amounted to 0.07%.

Total load of pesticides transported in water leaving the area during May-November in 1995 and 1996 were *ca.* 0.7 kg in both years (**Appendix 9**). Of this amount, pesticides used on courtyards (e.g. terbuthylazine and atrazine) constituted *ca.* 18% and another 2% was made up of pesticides originating from unknown sources. The remaining 80% of total amounts of pesticides detected in water originated in field use.

The total pesticide load in water has decreased markedly since the onset of the investigation seven years ago (**Figure 25**). In 1990, during May-September, a total of 2.5 kg of pesticide residues were transported in water leaving the catchment. The corresponding figure in 1996 was 0.5 kg. Pesticide load originating from application on courtyards has during most summers been in the order of 0.1 kg, with the exception of the summer of 1994, when *ca.* 0.6 kg lost originated from courtyard application, which was more than the total seasonal pesticide load during the following two years.

Those pesticides that were applied in the autumn, towards the end of each measurement period, were excluded from the transport estimates, calculated from autumn spraying onwards, presented in **Figure 25**. Amounts of these pesticides (preferably metazachlor) occurring in streamflow in September were generally small (<0.1 kg) during all years, with the exception of 1994. September 1994 was extremely wet with a 150 mm of rainfall. Following the autumn application, *ca.* 1 kg of metazachlor was lost in water during this month, corresponding to 0.44% of the applied amount.

Information on spring applied amounts of those pesticides occurring in the water is included in **Figure 25**. Comparatively more pesticides were lost during the first two years (*ca.* 0.2% of used amount), whereas the relation between transported and applied amounts have been quite constant during the following years (0.06-0.1%). Lost amounts have, however, decreased in absolute figures, in compliance with decreased amounts applied during spring and early summer.

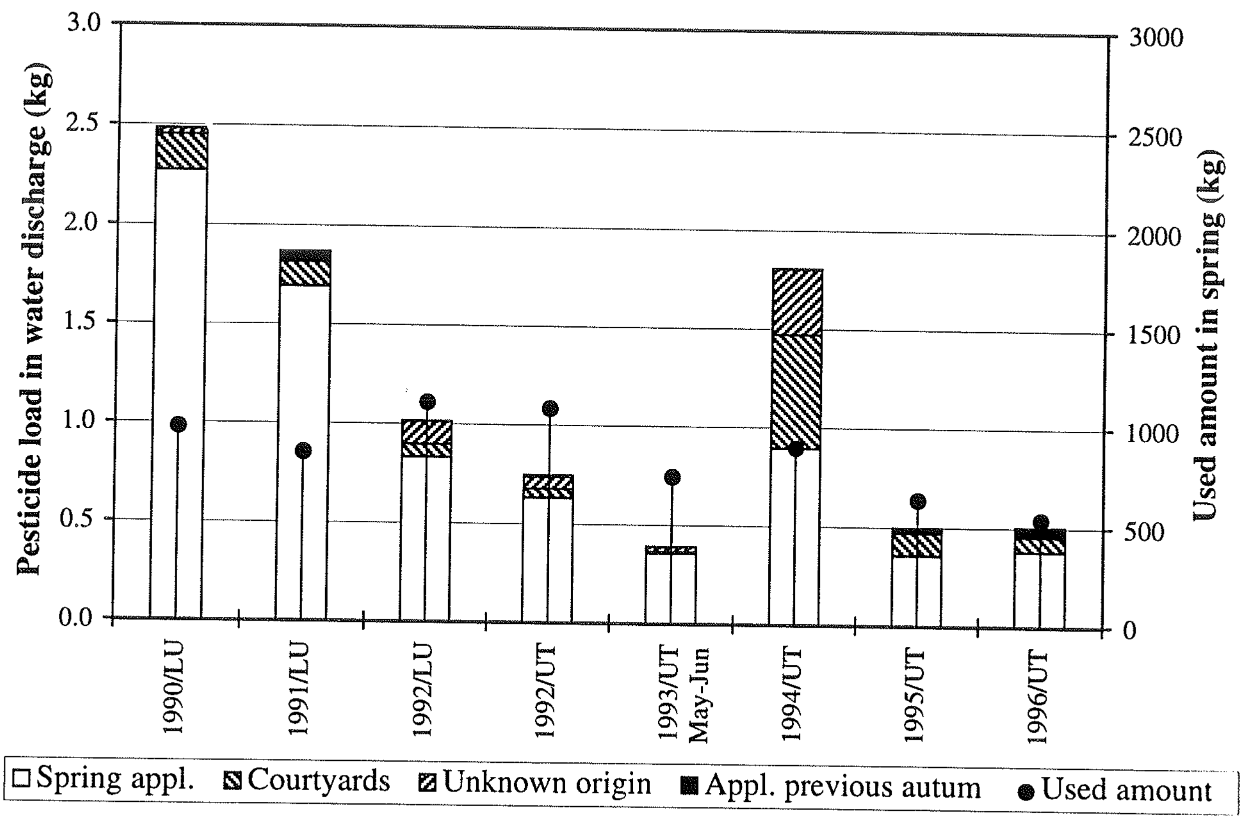

Figure 25. Transported amounts of pesticides in water during May-September at site LU12 1990-1992 and at site UT10 1992-1996. The bars in the figure are divided to present the origin of the pesticides transported, i.e. from pesticides used for spring application in the field, for courtyard application, of unknown origin and from application during the previous autumn.

DISCUSSION

Pesticide concentration levels and transported amounts were much lower during 1995-1996 than previously detected in water from this catchment. This improvement was largely a result of less quantities of pesticides being used. Losses, as percentage of used amounts, for single pesticides were comparable with those registered previously. Of the total amount used in the catchment, a larger proportion than previously was applied in the autumn, with an increased risk for surface water and groundwater contamination. The sampling period in 1995-1996 was extended to cover the autumn application season and the period shortly thereafter. The weather situation, though, was unusual both these autumns, with dry and warm conditions and low waterflow volumes. Results from 1995 and 1996, however, confirm that several of the pesticides applied in the autumn prevailed in the water during the following spring and summer.

Both in 1995 and in 1996 direct information was, for the first time, given to the farmers operating in the catchment on how to minimize the risk of pesticides contaminating stream water. Pesticide load in water discharge originating from either application on courtyards or in the field was, however, quite comparable with results obtained earlier, although the load resulting from field application was lower in absolute figures.

In a report by Linders et al. (1994), the toxicity of 243 evaluated pesticides to water organisms were compiled and data was available in this report for all but 4 of the 27 pesticides detected in water during 1995 and 1996. Data was missing for the herbicides benazolin-ethylester, terbuthylazine and tribenuron-methyl and the metabolite desethylatrazine. Two pesticides, the insecticide cyfluthrin and the herbicide isoproturon, exceeded their respective toxicity value given in Linders et al. (1994) for the most sensitive species. The maximum concentration detected of cyfluthrin, 5 µg/l as an average concentration during one week in 1996, was 35 times higher than the LC_{50}-value of 0.14 µg/l (i.e. the concentration required to kill 50% of the test organisms). Cyfluthrin was detected a second week at an average concentration of 0.9 µg/l, thus exceeding the LC_{50}-value by 6 times.

The maximum concentration detected for isoproturon, 10 µg/l as an average concentration during a two week period in November 1996, was 16 times higher than the NOEC-value of 0.64 µg/l (i.e. the highest concentration without adverse effect on algae). Altogether, isoproturon was detected at a weekly average concentration above the NOEC-value during three weeks in November 1995 and four weeks in November 1996. Three other herbicides (atrazine, metazachlor and prosulfocarb) had maximum, weekly average, concentrations just below their respective NOEC-values. For all other compounds detected concentrations were >10 times below the NOEC- or LC_{50}-value given for the most sensitive species.

Cyfluthrin and isoproturon were detected at concentrations above their toxicity values also during previous years in water samples from site UT10, along with 4 other pesticides (i.e. atrazine, cyanazine, esfenvalerate and methabenzthiazuron).

The limit of determination (LOD) for the five insecticides (cyfluthrin, deltamethrin, esfenvalerate, lambda-cyhalothrin and pirimicarb) used in the catchment was in the range 0.1-0.2 μg/l. The LOD used for all but one of the insecticides was close to, or in two cases even above, the LC_{50}-value given in Linders et al. (1994). Only pirimicarb had a LOD value 200 times below its LC_{50}-value (i.e. a better safety margin than the other four insecticides). This means that for several of the insecticides used in the catchment no definite statement can be made of their potential impact on the aquatic fauna in the stream.

Results from the first five years showed that pesticides detected in culvert discharge were often attenuated in the stream as a result of dilution by inflowing groundwater during low flow situations and, for some of the pesticides, adsorption to sediments. However, it was also demonstrated that concentration peaks in the stream varied to a great extent, with daily average concentrations sometimes varying by one order of magnitude from one day to another (Kreuger, 1996). This means that concentrations entering the stream can, during short periods of times, be considerably higher, or lower, than those weekly average concentrations obtained by the sampling procedure used in 1995-1996. The results from this investigation indicate that concentrations of some pesticides entering headwater streams in agricultural areas are close to, and during certain periods even above those levels demonstrated to have an impact on the aquatic flora and fauna.

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APPENDICES

Contents

Appendix 1. Used amount of pesticides, area treated, average dose and application period in area draining to UT10 during autumn 1994

Autumn 1994	**Total amount**	**Total area**	**Av. dose**	**Spraying period**	
Active ingredient	**(kg)**	**(ha)**	**(kg/ha)**	**Start**	**End**
bromoxynil	0.4	6	0.07	94-10-14	
cycloxydim	25.9	156	0.17	94-09-01	94-09-25
cyfluthrin	0.02	2	0.01	94-09-05	
dichlorprop-P	2.0	6	0.33	94-10-14	
diflufenican	4.7	42	0.11	94-10-05	94-10-25
glyphosate	23.3	18	1.32	94-08-28	94-10-06
ioxynil	0.6	6	0.10	94-10-14	
isoproturon	51.8	55	0.94	94-10-01	94-10-25
lambda-cyhalothrin	0.4	101	0.004	94-08-31	
MCPA	1.4	6	0.23	94-10-14	
mecoprop-P	4.2	7	0.60	94-10-01	
metazachlor	211.7	203	1.04	94-08-25	94-09-25
sethoxydim	1.7	4	0.43	94-09-12	
	328.1	267	1.23		
Herbicides	327.7	266	1.23		
Fungicides					
Insecticides	0.4	102	0.004		
Growth regulators					

Appendix 2. Used amount of pesticides, area treated, average dose and application period in area draining to UT10 during spring and early summer 1995

Spring/summer 1995	**Total amount**	**Total area**	**Av. dose**	**Spraying period**	
Active ingredient	**(kg)**	**(ha)**	**(kg/ha)**	**Start**	**End**
bromoxynil	2.9	37	0.08	95-05-16	95-05-28
chloridazon	59.2	44	1.35	95-04-05	95-06-04
chlormequat chloride	5.6	4	1.37	95-05-02	
clopyralid	0.2	2	0.13	95-04-28	
cyfluthrin	0.3	18	0.02	95-05-10	95-06-20
dichlorprop-P	13.2	37	0.36	95-05-16	95-05-28
esfenvalerate	0.6	38	0.02	95-05-15	95-07-03
ethofumesate	32.7	138	0.24	95-05-05	95-06-12
fenpropimorph	52.3	234	0.22	95-04-20	95-07-03
fluroxypyr	5.9	53	0.11	95-04-15	95-05-25
glyphosate	20.6	31	0.67	95-04-05	95-07-05
ioxynil	4.3	37	0.12	95-05-16	95-05-28
isoproturon	21.9	17	1.28	95-04-15	95-05-03
lambda-cyhalothrin	1.1	159	0.007	95-05-03	95-07-03
MCPA	28.4	60	0.47	95-04-20	95-05-28
mecoprop-P	91.3	136	0.67	95-04-15	95-06-04
metamitron	317.1	148	2.15	95-04-25	95-06-12
methabenzthiazuron	3.9	4	1.05	95-04-05	
phenmedipham	62.5	148	0.42	95-04-25	95-06-12
pirimicarb	2.6	17	0.15	95-06-15	95-06-25
propiconazole	17.4	234	0.07	95-04-20	95-07-03
sethoxydim	6.6	8	0.88	95-05-25	95-06-05
tribenuron-methyl	2.0	217	0.009	95-04-15	95-07-01*
	752.6	615	1.22		
Herbicides	672.7	447	1.50		
Fungicides	69.7	234	0.30		
Insecticides	4.6	231	0.02		
Growth regulators	5.6	4	1.40		

* Applied in fallow on one occasion in 95-07-01, spraying in cereals ended 95-06-04.

Appendix 3. Used amount of pesticides, area treated, average dose and application period in area draining to UT10 during autumn 1995

Autumn 1995 **Active ingredient**	**Total amount (kg)**	**Total area (ha)**	**Av. dose (kg/ha)**	**Spraying period Start**	**End**
cycloxydim	14.1	97	0.15	95-09-03	95-10-03
diflufenican	22.6	218	0.10	95-09-25	95-10-17
glyphosate	12.1	14	0.84	95-08-10	95-09-14
isoproturon	219.8	231	0.95	95-09-25	95-10-17
lambda-cyhalothrin	0.1	51	0.002	95-10-03	
mecoprop-P	69.7	114	0.61	95-10-05	95-10-17
metazachlor	126.9	119	1.06	95-09-03	95-10-03
prosulfocarb	40.8	17	2.40	95-10-26	
sethoxydim	8.5	20	0.44	95-09-14	95-09-15
	514.6	879	0.59		
Herbicides	514.5	324	1.59		
Fungicides					
Insecticides	0.1	51	0.002		
Growth regulators					

Appendix 4. Used amount of pesticides, area treated, average dose and application period in area draining to UT10 during spring and early summer 1996

Spring/summer 1996	Total amount	Total area	Av. dose	Spraying period	
Active ingredient	**(kg)**	**(ha)**	**(kg/ha)**	**Start**	**End**
aclonifen	0.9	2	0.60	96-05-20	
bentazone	8.6	13	0.69	96-05-20	96-05-25
bromoxynil	1.0	16	0.06	96-05-15	96-05-23
carbendazim	1.7	17	0.10	96-05-14	
chloridazon	8.7	10	0.84	96-04-27	96-06-07
chlormequat chloride	2.4	3	0.92	96-04-20	
clopyralid	0.8	12	0.07	96-05-14	96-05-15
cycloxydim	2.7	10	0.28	96-06-05	96-06-15
cyfluthrin	0.5	25	0.02	96-05-14	96-07-25
deltamethrin	0.4	47	0.009	96-05-10	96-06-26
dichlorprop-P	29.4	96	0.31	96-05-15	96-06-05
esfenvalerate	2.6	166	0.02	96-05-20	96-07-29
ethofumesate	15.3	65	0.23	96-05-08	96-06-07
fenpropimorph	142.4	465	0.31	96-05-13	96-07-15
fluroxypyr	20.3	283	0.07	96-04-20	96-06-07
glyphosate	0.7	1	0.70	96-07-01	
ioxynil	1.6	16	0.10	96-05-15	96-05-23
lambda-cyhalothrin	1.7	175	0.01	96-05-13	96-06-28
MCPA	78.9	177	0.45	96-04-20	96-06-05
mecoprop-P	32.3	107	0.30	96-05-14	96-06-07
metamitron	142.6	74	1.92	96-05-07	96-06-07
phenmedipham	28.3	74	0.38	96-05-07	96-06-07
pirimicarb	9.4	94	0.10	96-06-12	96-07-30
propiconazole	49.6	465	0.11	96-05-13	96-07-15
triadimenol	0.7	9	0.08	96-06-28	
tribenuron-methyl	3.7	423	0.009	96-04-20	96-06-07
	587.2	684	0.86		
Herbicides	375.9	552	0.68		
Fungicides	194.4	465	0.42		
Insecticides	14.5	427	0.03		
Growth regulators	2.4	3	0.80		

Appendix 5. Used amount of pesticides, area treated, average dose and application period in area draining to UT10 during autumn 1996

Autumn 1996	**Total amount**	**Total area**	**Av. dose**	**Spraying period**	
Active ingredient	**(kg)**	**(ha)**	**(kg/ha)**	**Start**	**End**
diflufenican	17.4	216	0.08	96-10-06	96-10-15
glyphosate	45.2	50	0.90	96-08-20	96-10-15
isoproturon	185.3	218	0.85	96-10-06	96-10-15
metazachlor	13.0	9	1.49	96-08-10	96-10-05
	260.9	250	1.04		
Herbicides	260.9	250	1.04		
Fungicides					
Insecticides					
Growth regulators					

Appendix 6. List of active ingredients used and trade names of the commercial products

Active ingredient	Trade name
aclonifen	Fenix
bentazone	Basagran 480
bromoxynil	Certrol-P
	Oxitril-P
carbendazim	Start
chloridazon	Pyramin DF
chlormequat chloride	Cycocel Plus
clopyralid	Ariane S
	Matrigon
cycloxydim	Focus Ultra
cyfluthrin	Baytroid 050 EC
deltamethrin	Decis
dichlorprop-P	Certrol-P
	Duplosan Super
	Oxitril-P
diflufenican	Cougar
esfenvalerate	Sumi-alpha 5 FW
ethofumesate	Betanal Tandem
	Partner
	Tramat 50 SC
fenpropimorph	Tilt Top 500 EC
fluroxypyr	Ariane S
	Starane 180
glyphosate	Avans 330
	Roundup Bio
ioxynil	Certrol-P
	Oxitril-P
isoproturon	Arelon Flytande
	Cougar
	Tolkan
lambda-cyhalothrin	Karate 2.5 EW
MCPA	Ariane S
	Certrol-P
	Duplosan Super
	Hormotex 750
	MCPA 750
	Oxitril-P
mecoprop-P	Duplosan Meko
	Duplosan Super
	Mekoprop
metamitron	Goltix WG
metazachlor	Butisan S
methabenzthiazuron	Tribunil
phenmedipham	Betanal OF
	Betanal Tandem
	Kemifam Flow
pirimicarb	Pirimor
propiconazole	Tilt Top 500 EC
	Start
prosulfocarb	Boxer
sethoxydim	Expand Plus
triadimenol	Bayfidan
tribenuron-methyl	Express 50 T

Trade name	Type	Class	Active ingredient	Quantity (g/l or kg)
Arelon Flytande	herbicide	2L	isoproturon	500
Ariane S	herbicide	2L	MCPA	200
			fluroxypyr	40
			clopyralid	20
Avans 330	herbicide	2L	glyphosate	330
Basagran 480	herbicide	2L	bentazone	480
Bayfidan	fungicide	2L	triadimenol	250
Baytroid 050 EC	insecticide	2L	cyfluthrin	50
Betanal OF	herbicide	2L	phenmedipham	160
Betanal Tandem	herbicide	2L	ethofumesate	100
			phenmedipham	80
Boxer	herbicide	2L	prosulfocarb	800
Butisan S	herbicide	2L	metazachlor	500
Certrol-P	herbicide	2L	dichlorprop-P	165
			MCPA	120
			ioxynil	54
			bromoxynil	36
Cougar	herbicide	2L	isoproturon	500
			diflufenican	100
Cycocel Plus	growth reg.	2L	chlormequat chloride	460
Decis	insecticide	2L	deltamethrin	25
Duplosan Meko	herbicide	2L	mecoprop-P	600
Duplosan Super	herbicide	2L	dichlorprop-P	310
			MCPA	160
			mecoprop-P	130
Expand Plus	herbicide	2L	sethoxydim	437
Express 50 T	herbicide	2L	tribenuron-methyl	500
Fenix	herbicide	2L	aclonifen	600
Focus Ultra	herbicide	2L	cycloxydim	100
Goltix WG	herbicide	2L	metamitron	700
Hormotex 750	herbicide	2L	MCPA	750
Karate 2.5 EW	insecticide	2L	lambda-cyhalothrin	25
Kemifam Flow	herbicide	2L	phenmedipham	160
Matrigon	herbicide	2L	clopyralid	100
MCPA 750	herbicide	2L	MCPA	750
Mekoprop	herbicide	2L	mecoprop-P	600
Oxitril-P	herbicide	2L	dichlorprop-P	165
			MCPA	120
			ioxynil	54
			bromoxynil	36
Partner	herbicide	2L	ethofumesate	500
Pirimor	insecticide	2L	pirimicarb	500
Pyramin DF	herbicide	2L	chloridazon	650
Roundup Bio	herbicide	2L	glyphosate	360
Starane 180	herbicide	2L	fluroxypyr	180
Start	fungicide	1L	propiconazole	250
			carbendazim	200
Sumi-alpha 5 FW	insecticide	2L	esfenvalerate	50
Tilt Top 500 EC	fungicide	2L	fenpropimorph	375
			propiconazole	125
Tolkan	herbicide	2L	isoproturon	500
Tramat 50 SC	herbicide	2L	ethofumesate	500
Tribunil	herbicide	2L	methabenzthiazuron	700

Appendix 7. Pesticide concentrations in time integrated water samples from site UT10 1995-1996

ISCO UT10									
Datum	atrazine	atrazine-desethyl	BAM	benazolinethylester	bentazone	chloridazon	clopyralid	cyanazine	cyfluthrin
95-04-27	<0,1	<0,2	<0,1	<0,1	<0,1	<0,5	<0,3	<0,1	<0,2
95-05-07	<0,1	<0,2	<0,1	<0,1	<0,1	<0,5	<0,3	<0,1	<0,2
95-05-14	**(0.06)**	<0,2	<0,1	<0,1	**(0.05)**	<0,5	<0,3	<0,1	<0,2
95-05-21	**(0.07)**	<0,2	<0,1	<0,1	<0,1	<0,5	<0,3	**(0.07)**	<0,2
95-05-28	<0,1	<0,2	<0,1	<0,1	<0,1	<0,5	<0,3	<0,1	<0,2
95-06-04	**(0.05)**	<0,2	<0,1	**0.4**	**0.2**	**0.5**	<0,3	**0.2**	<0,2
95-06-11	**(0.05)**	<0,2	<0,1	**(0.06)**	<0,1	**0.6**	<0,3	**(0.07)**	<0,2
95-06-18	**(0.05)**	<0,2	<0,1	<0,1	**(0.07)**	<0,5	<0,3	**(0.05)**	<0,2
95-06-25	<0,1	<0,2	<0,1	<0,1	<0,1	<0,5	<0,3	<0,1	<0,2
95-07-02	<0,1	<0,2	<0,1	<0,1	<0,1	<0,5	<0,3	<0,1	<0,2
95-07-09	**(0.05)**	<0,2	<0,1	<0,1	<0,1	<0,5	<0,3	**0.1**	<0,2
95-07-16	<0,1	<0,2	<0,1	<0,1	<0,1	<0,5	<0,3	<0,1	<0,2
	Low flow situation!								
95-08-27	Start!								
95-09-03	**0.07**	<0,3	<0,2	<0,1	**0.1**	<0,5	<0,3	**0.1**	<0,2
95-09-10	**0.1**	<0,3	<0,2	<0,1	**0.2**	<0,5	<0,3	**(0.05)**	<0,2
95-09-17	**0.2**	<0,3	<0,1	<0,1	**0.3**	<0,5	<0,3	**0.1**	<0,2
95-09-24	**0.2**	<0,3	<0,1	<0,1	**0.3**	<0,5	<0,3	**0.2**	<0,2
95-10-01	**0.07**	<0,3	<0,1	<0,1	**0.3**	<0,5	<0,3	**(0.05)**	<0,2
95-10-08	**0.06**	<0,3	<0,1	<0,1	**0.2**	<0,5	<0,3	<0,1	<0,2
	Low flow situation!								
95-10-30	Start!								
95-11-05	**(0.08)**	<0,3	<0,1	<0,1	**0.3**	<0,5	<0,3	<0,1	<0,2
95-11-12	**(0.06)**	<0,3	<0,1	<0,1	**0.3**	<0,5	<0,3	<0,1	<0,2
95-11-19	**(0.05)**	<0,3	<0,1	<0,1	**0.5**	<0,5	<0,3	<0,2	<0,2
95-11-26	<0,1	<0,3	<0,1	<0,1	**0.3**	<0,5	<0,3	<0,1	<0,2
96-05-08	<0,1	<0,3	<0,1	<0,1	**(0.07)**	<0,6	<0,3	<0,1	<0,2
96-05-12	**(0.05)**	<0,3	<0,1	<0,1	<0,1	<0,6	<0,7	<0,1	<0,2
96-05-19	**0.4**	<0,3	<0,1	<0,1	**0.09**	<0,6	<0,7	<0,1	<0,2
96-05-26	**0.4**	<0,3	<0,1	<0,1	<0,3	<0,6	<0,3	<0,1	<0,2
96-06-02	**0.07**	<0,3	<0,1	<0,1	<0,3	<0,5	<0,3	<0,1	<0,2
96-06-09	**(0.05)**	<0,3	<0,1	<0,1	<0,3	<0,5	<0,3	<0,1	<0,2
96-06-16	**(0.05)**	<0,2	<0,1	<0,1	**0.2**	<0,5	<0,3	<0,1	<0,2
96-06-23	<0,1	<0,3	<0,1	<0,1	**0.2**	**0.3**	<0,3	<0,1	<0,2
96-06-30	**0.2**	<0,3	<0,1	<0,1	**1**	**0.6**	<0,3	**0.4**	<0,2
96-07-07	**0.9**	<0,3	<0,1	<0,1	**0.9**	<0,5	<0,3	<0,1	<0,2
96-07-14	**0.3**	<0,3	<0,1	<0,1	**0.4**	<0,5	<0,4	<0,1	<0,2
96-07-21	**0.1**	<0,3	<0,1	<0,1	**0.3**	<0,5	<0,3	<0,1	<0,2
96-07-28	**0.1**	<0,3	<0,1	<0,1	**0.2**	<0,5	<0,3	<0,1	<0,2
96-08-04	**0.1**	<0,3	<0,1	<0,1	**0.5**	<0,5	<0,3	<0,1	**5**
	Low flow situation!								
96-09-07	Start!								
96-09-14	**0.3**	<0,2	<0,2	<0,1	**0.09**	<0,5	<0.3	<0,1	<0,2
	Low flow situation!								
96-09-22	Start!								
96-09-29	**(0.05)**	<0,2	<0,1	<0,1	<0.1	<0,5	<0.3	<0,1	**0.9**
96-10-06	**0.2**	<0,2	<0,1	<0,1	**(0.08)**	<0,5	<0.3	<0,1	<0,2
	Low flow situation!								
96-10-27	Start!								
96-11-03	**0.6**	**(0.1)**	<0,2	<0,1	**0.2**	<0,1	<0.3	<0,1	<0,2
96-11-10	**0.5**	**(0.1)**	<0,2	<0,1	**0.2**	<0,1	<0.4	<0,1	<0,2
96-11-17	**0.2**	<0,2	<0,1	<0,1	**0.19**	<0,2	<0.1	<0,1	<0,2
96-11-24	**0.1**	<0,2	<0,1	<0,1	**0.15**	<0,2	<0.1	<0,1	<0,2
96-12-01	**(0.05)**	<0,2	<0,1	<0,1	**0.12**	<0,2	<0.1	<0,1	<0,2

Appendix 7. Pesticide concentrations in time integrated water samples from site UT10 1995-1996

ISCO UT10									
Datum	2,4-D	deltamethrin	dichlobenil	dichlorprop	diflufenican	dimethoate	diuron	esfenvalerate	ethofumesate
95-04-27	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,2	<0,1	<0,1
95-05-07	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,2	<0,1	<0,1
95-05-14	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,1	<0,1	<0,1
95-05-21	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,1	<0,1	**(0.06)**
95-05-28	<0,1	<0,1	<0,1	**(0.1)**	n.a.	<0,1	<0,1	<0,1	**(0.06)**
95-06-04	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,1	<0,1	**0.7**
95-06-11	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,1	<0,1	**0.9**
95-06-18	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,1	<0,1	**0.5**
95-06-25	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,1	<0,1	**0.1**
95-07-02	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,1	<0,1	**(0.09)**
95-07-09	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,1	<0,1	**(0.09)**
95-07-16	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,1	<0,1	**(0.05)**
95-08-27									
95-09-03	<0,1	<0,1	<0,1	**0.2**	n.a.	<0,1	<0,2	<0,1	**0.1**
95-09-10	<0,1	<0,1	<0,1	**0.2**	n.a.	<0,1	<0,2	<0,1	**0.3**
95-09-17	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,2	<0,1	**0.2**
95-09-24	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,2	<0,1	**0.1**
95-10-01	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,2	<0,1	**(0.05)**
95-10-08	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,2	<0,1	<0,1
95-10-30									
95-11-05	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,3	<0,1	**0.1**
95-11-12	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,3	<0,1	**(0.05)**
95-11-19	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,3	<0,1	**(0.06)**
95-11-26	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,3	<0,1	<0,1
96-05-08	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,5	<0,1	<0,1
96-05-12	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,5	<0,1	<0,1
96-05-19	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,5	<0,1	**0.2**
96-05-26	<0,1	<0,1	<0,1	<0,1	n.a.	<0,1	<0,5	<0,1	**0.09**
96-06-02	<0,1	<0,1	<0,1	**1**	n.a.	<0,1	<0,2	<0,1	<0,1
96-06-09	<0,1	<0,1	<0,1	**9**	n.a.	<0,1	<0,2	<0,1	**(0.05)**
96-06-16	<0,2	<0,1	<0,1	**10**	n.a.	<0,1	<0,2	<0,1	**(0.05)**
96-06-23	<0,2	<0,1	<0,1	**3**	n.a.	<0,1	<0,1	<0,1	**0.09**
96-06-30	<0,2	<0,1	<0,1	**20**	n.a.	<0,1	<0,1	<0,1	**0.2**
96-07-07	<0,2	<0,1	<0,1	**2**	**0.08**	<0,1	<0,2	<0,1	**0.2**
96-07-14	<0,2	<0,1	<0,1	**0.9**	**0.1**	<0,1	<0,2	<0,1	<0,1
96-07-21	**0.1**	<0,1	<0,1	**0.8**	**0.1**	<0,1	<0,2	<0,1	**0.1**
96-07-28	<0,1	<0,1	<0,1	**0.1**	**0.1**	<0,1	<0,2	<0,1	**0.1**
96-08-04	<0,1	<0,1	<0,1	<0,1	**0.1**	**30**	**(0.1)**	<0,1	**0.2**
96-09-07									
96-09-14	**(0.05)**	<0,1	<0,1	**0.7**	**0.09**	<0,1	**0.1**	<0,1	**0.2**
96-09-22									
96-09-29	<0.1	<0,1	<0,1	**(0.05)**	**0.1**	<0,1	**0.2**	<0,1	**0.1**
96-10-06	<0.1	<0,1	<0,1	**0.2**	**0.08**	<0,1	**0.1**	<0,1	**0.1**
96-10-27									
96-11-03	<0.1	<0,1	<0,1	**0.2**	**0.3**	<0,1	<0,2	<0,1	**0.2**
96-11-10	<0.1	<0,1	<0,1	**(0.05)**	**0.3**	<0,1	<0,2	<0,1	**0.2**
96-11-17	<0.1	<0,1	<0,1	<0.1	**0.1**	<0,1	<0,2	<0,1	<0,1
96-11-24	<0.1	<0,1	<0,1	<0.1	**0.1**	<0,1	<0,2	<0,1	<0,1
96-12-01	<0.1	<0,1	<0,1	<0.1	**0.1**	<0,1	<0,2	<0,1	<0,1

Appendix 7. Pesticide concentrations in time integrated water samples from site UT10 1995-1996

ISCO UT10									
Datum	fenpropimorph	flamprop-M	fluroxypyr	hexazinon	isoproturon	l-cyhalotrin	linuron	MCPA	mecoprop
95-04-27	<0,1	<0,2	<0,3	<0,1	<0,2	<0,1	<0,2	<0,1	**0.09**
95-05-07	<0,1	<0,1	<0,2	<0,1	<0,2	<0,1	<0,2	<0,1	**(0.05)**
95-05-14	<0,1	<0,1	<0,2	<0,1	<0,2	<0,1	<0,5	<0,1	**0.3**
95-05-21	<0,1	<0,1	<0,2	<0,1	<0,2	<0,1	<0,5	<0,1	**0.6**
95-05-28	<0,1	<0,2	<0,3	<0,1	<0,2	<0,1	<0,5	**0.9**	**0.3**
95-06-04	<0,1	<0,2	<0,3	<0,1	<0,2	<0,1	<0,5	**0.2**	**8**
95-06-11	<0,1	<0,2	<0,3	<0,1	<0,2	<0,1	<0,5	**0.2**	**0.4**
95-06-18	<0,1	<0,2	<0,3	<0,1	<0,2	<0,1	<0,5	**(0.08)**	**0.1**
95-06-25	**0.1**	n.a.	n.a.	<0,1	<0,2	<0,1	<0,5	**(0.1)**	**0.1**
95-07-02	**0.6**	n.a.	n.a.	<0,1	<0,2	<0,1	<0,5	<0,1	**(0.06)**
95-07-09	**0.1**	n.a.	n.a.	<0,1	<0,2	<0,1	<0,5	<0,1	<0,1
95-07-16	**(0.05)**	n.a.	n.a.	<0,1	<0,2	<0,1	<0,5	<0,1	**(0.06)**
95-08-27									
95-09-03	**0.1**	n.a.	n.a.	<0,1	**(0.1)**	<0,1	<0,3	<0,1	**(0.06)**
95-09-10	**0.2**	n.a.	n.a.	**0.05**	**(0.1)**	<0,1	<0,3	<0,1	**0.2**
95-09-17	**0.1**	n.a.	n.a.	**0.07**	**0.6**	<0,1	<0,3	<0,1	**0.1**
95-09-24	**0.1**	n.a.	n.a.	**0.09**	**0.6**	<0,1	<0,3	<0,1	**(0.07)**
95-10-01	<0,1	n.a.	n.a.	<0,1	<0,2	<0,1	<0,3	<0,1	**(0.08)**
95-10-08	<0,1	n.a.	n.a.	<0,1	<0,2	<0,1	<0,3	<0,1	**(0.06)**
95-10-30									
95-11-05	**(0.05)**	n.a.	n.a.	<0,1	**4**	<0,1	<0,2	<0,1	**5**
95-11-12	<0,1	n.a.	n.a.	<0,1	**4**	<0,1	<0,2	<0,1	**2**
95-11-19	<0,1	n.a.	n.a.	<0,1	**5**	<0,1	<0,2	<0,1	**0.7**
95-11-26	<0,1	n.a.	n.a.	<0,1	**0.8**	<0,1	<0,2	<0,1	**0.4**
96-05-08	<0,1	n.a.	<0,2	<0,1	**0.2**	<0,1	<0,2	<0,1	**(0.07)**
96-05-12	<0,1	n.a.	<0,2	<0,1	**0.2**	<0,1	<0,2	<0,1	**(0.07)**
96-05-19	**0.3**	n.a.	<0,2	<0,1	**0.4**	<0,1	<0,2	<0,1	**0.7**
96-05-26	<0,1	<0,2	<0,4	<0,1	**0.2**	<0,1	<0,2	**0.05**	**0.2**
96-06-02	<0,1	<0,2	<0,4	<0,1	**0.07**	<0,1	<0,1	**0.8**	**0.6**
96-06-09	**0.1**	<0,2	<0,4	<0,1	**0.2**	<0,1	<0,1	**4**	**3**
96-06-16	**(0.05)**	<0,2	**0.4**	<0,1	**0.1**	<0,1	<0,2	**3**	**4**
96-06-23	<0,1	<0,2	**0.2**	<0,1	**0.1**	<0,1	<0,2	**0.7**	**3**
96-06-30	**0.2**	<0,2	**5**	<0,1	**0.3**	<0,1	<0,2	**5**	**8**
96-07-07	**0.4**	<0,2	**2**	<0,1	**0.3**	<0,1	<0,2	**1**	**1**
96-07-14	**0.7**	<0,2	**0.5**	<0,1	**0.2**	<0,1	<0,2	**0.6**	**0.8**
96-07-21	**0.2**	<0,2	**0.9**	<0,1	**0.2**	<0,1	<0,2	**0.3**	**0.4**
96-07-28	**0.4**	<0,2	**1**	<0,1	**0.1**	<0,1	<0,2	**0.1**	<0,1
96-08-04	**0.3**	<0,2	**1**	<0,1	**0.1**	<0,1	<0,2	<0,1	<0,1
96-09-07									
96-09-14	**0.2**	<0.1	**0.4**	<0,2	**0.1**	<0,1	<0,5	**0.2**	**0.2**
96-09-22									
96-09-29	**0.3**	<0.1	<0.5	<0,1	**0.2**	<0,1	<0,2	<0.1	<0.1
96-10-06	**0.2**	<0.05	<0.5	<0,1	**0.3**	<0,1	<0,2	**(0.07)**	**0.1**
96-10-27									
96-11-03	**0.1**	<0.05	**0.4**	<0,2	**10**	<0,1	<0.3	**0.06**	**1**
96-11-10	**0.1**	<0.05	**0.4**	<0,2	**10**	<0,1	<0.3	<0.1	**1**
96-11-17	**(0.05)**	<0.1	**1.8**	<0,2	**3**	<0,1	<0,5	<0.1	**0.2**
96-11-24	**(0.05)**	<0.1	**1.5**	<0,2	**3**	<0,1	<0,5	<0.1	**0.26**
96-12-01	<0.1	<0.1	**0.5**	<0,2	**0.7**	<0,1	<0,5	<0.1	<0.1

Appendix 7. Pesticide concentrations in time integrated water samples from site UT10 1995-1996

ISCO UT10								
Datum	metamitron	metazachlor	methabenzthiazuron	phenmedipham	pirimicarb	prochloraz	propiconazole	propyzamide
95-04-27	<0,5	**(0.05)**	<0,5	<1	<0,1	<0,5	<0,1	<0,1
95-05-07	<0,5	**(0.05)**	<0,5	<1	<0,1	<0,5	<0,1	<0,1
95-05-14	<0,5	**(0.1)**	<0,2	<1	<0,1	<0,5	<0,2	<0,1
95-05-21	**1**	**(0.1)**	<0,2	<1	<0,1	<0,5	<0,2	<0,1
95-05-28	**(0.2)**	**0.2**	<0,2	<1	<0,1	<0,5	<0,2	<0,1
95-06-04	**6**	**0.2**	<0,2	<1	<0,1	<0,5	<0,2	<0,1
95-06-11	**5**	**(0.1)**	<0,2	<1	<0,1	<0,5	<0,2	<0,1
95-06-18	**0.7**	**(0.1)**	<0,2	<1	<0,1	<0,5	<0,2	<0,1
95-06-25	<0,5	**0.2**	<0,2	<1	<0,1	<0,5	<0,2	<0,1
95-07-02	<0,5	**0.2**	<0,2	<1	<0,1	<0,5	**(0.1)**	<0,1
95-07-09	<0,5	**0.2**	<0,2	<1	<0,1	<0,5	**(0.1)**	<0,1
95-07-16	<0,5	**(0.1)**	<0,2	<1	<0,1	<0,5	**(0.05)**	<0,1
95-08-27								
95-09-03	<0,5	**0.06**	<0,5	<1	**0.1**	<0,2	**0.6**	<0,1
95-09-10	<0,5	**100**	<0,5	<1	**0.1**	<0,2	**0.6**	<0,1
95-09-17	<1	**3**	<0,5	<1	**0.1**	<0,5	**1**	<0,1
95-09-24	<1	**2**	<0,5	<1	**0.1**	<0,5	**0.7**	<0,1
95-10-01	<0,5	**0.9**	<0,5	<1	**(0.05)**	<0,5	**0.1**	<0,1
95-10-08	<0,5	**1**	<0,5	<1	<0,1	<0,2	**0.1**	<0,1
95-10-30								
95-11-05	<0,5	**1**	<0,5	<1	<0,1	<0,2	**(0.09)**	<0,1
95-11-12	<0,5	**1**	<0,5	<1	<0,1	<0,2	**(0.05)**	<0,1
95-11-19	<0,5	**0.9**	<0,5	<1	<0,1	<0,2	**0.1**	<0,1
95-11-26	<0,5	**0.3**	<0,5	<1	<0,1	<0,2	<0,1	<0,1
96-05-08	<0,5	**0.1**	<0,2	<1	<0,1	<0,5	<0,2	<0,1
96-05-12	<0,5	**0.2**	<0,2	<1	<0,1	<0,5	<0,2	<0,1
96-05-19	**1**	**0.4**	<0,2	<1	<0,1	<0,5	**0.2**	<0,1
96-05-26	<0,5	**0.3**	<0,2	<1	<0,1	<0,5	**(0.1)**	<0,1
96-06-02	<0,5	**0.09**	<0,2	<1	<0,1	<0,5	<0,1	<0,1
96-06-09	<0,5	**0.1**	<0,2	<1	<0,1	<0,5	**0.08**	<0,1
96-06-16	<0,5	**0.1**	<0,2	<1	<0,1	<0,5	**(0.05)**	<0,1
96-06-23	**0.5**	**0.3**	<0,2	<1	**(0.05)**	<0,2	**0.1**	<0,1
96-06-30	**0.8**	**0.3**	<0,2	<1	<0,1	<0,5	**0.5**	<0,1
96-07-07	<0,5	**0.4**	<0,2	<1	**(0.05)**	<0,5	**1**	<0,1
96-07-14	<0,5	**0.2**	<0,2	<1	<0,1	<0,5	**1**	<0,1
96-07-21	<0,5	**0.3**	<0,2	<1	**0.07**	<0,5	**2**	<0,1
96-07-28	<0,5	**0.3**	<0,2	<1	**0.1**	<0,5	**2**	<0,1
96-08-04	<0,5	**0.5**	<0,2	<1	**0.7**	<0,5	**2**	<0,1
96-09-07								
96-09-14	<0,5	**0.2**	<0,3	<1	**0.4**	<0,5	**0.9**	<0,1
96-09-22								
96-09-29	<0,5	<0,1	<0,3	<1	**0.09**	<0,5	**0.8**	<0,1
96-10-06	<0,5	**0.3**	<0,3	<1	**0.2**	<0,5	**0.6**	<0,1
96-10-27								
96-11-03	<0,2	**0.3**	<0.5	<1	**0.2**	<0.3	**0.6**	<0,1
96-11-10	<0,2	**0.5**	<0.5	<1	**0.2**	<0.3	**0.6**	<0,1
96-11-17	<0,3	<0,2	<0,3	<1	<0,1	<0.2	**0.3**	<0,1
96-11-24	<0,3	<0,2	<0,3	<1	<0,1	<0.2	**0.2**	<0,1
96-12-01	<0,3	<0,2	<0,3	<1	<0,1	<0.2	**0.1**	<0,1

Appendix 7. Pesticide concentrations in time integrated water samples from site UT10 1995-1996

ISCO UT10							
Datum	prosulfocarb	simazine	terbuthylazine	triadimenol	tribenuron-methyl	Sum pest	Av. flow (l/s)
95-04-27	n.a.	<0,1	**(0.05)**	<0,2	n.a.	**0.2**	71
95-05-07	n.a.	<0,1	**(0.05)**	<0,2	<0,005	**0.2**	36
95-05-14	n.a.	<0,1	**1**	<0,2	<0,005	**1.5**	26
95-05-21	n.a.	<0,1	**1**	<0,2	**0.008**	**2.9**	23
95-05-28	n.a.	<0,1	**0.1**	<0,2	n.a.	**1.9**	16
95-06-04	n.a.	<0,1	**1**	<0,2	n.a.	**17.5**	15
95-06-11	n.a.	<0,1	**0.9**	<0,2	n.a.	**8.3**	27
95-06-18	n.a.	<0,1	**0.9**	<0,2	n.a.	**2.6**	46
95-06-25	n.a.	<0,1	**0.2**	<0,2	n.a.	**0.8**	20
95-07-02	n.a.	<0,1	**0.4**	<0,2	n.a.	**1.5**	9
95-07-09	n.a.	<0,1	**0.9**	<0,2	n.a.	**1.5**	5
95-07-16	n.a.	<0,1	**0.3**	<0,2	n.a.	**0.6**	3
95-08-27							
95-09-03	n.a.	**0.08**	**2**	<0,2	n.a.	**3.7**	1
95-09-10	n.a.	**0.09**	**2**	<0,2	n.a.	**104.2**	1
95-09-17	n.a.	**0.1**	**3**	<0,2	n.a.	**8.9**	2
95-09-24	n.a.	**0.1**	**4**	<0,2	n.a.	**8.6**	1
95-10-01	n.a.	<0,1	**0.9**	<0,2	n.a.	**2.5**	2
95-10-08	n.a.	<0,1	**0.6**	<0,2	n.a.	**2.0**	2
95-10-30							
95-11-05	n.a.	<0,1	**0.6**	<0,2	n.a.	**11.2**	6
95-11-12	n.a.	<0,1	**0.4**	<0,2	n.a.	**7.9**	4
95-11-19	n.a.	<0,1	**0.9**	<0,2	n.a.	**8.2**	6
95-11-26	n.a.	<0,1	**0.2**	<0,2	n.a.	**2.0**	4
96-05-08	n.a.	<0,1	**0.08**	<0,2	n.a.	**0.5**	11
96-05-12	n.a.	<0,1	**0.1**	<0,2	n.a.	**0.6**	8
96-05-19	n.a.	<0,1	**0.2**	<0,2	n.a.	**3.9**	8
96-05-26	n.a.	<0,1	**0.1**	<0,2	n.a.	**1.4**	74
96-06-02	n.a.	<0,1	**1**	<0,2	n.a.	**3.6**	26
96-06-09	n.a.	<0,1	**0.3**	<0,2	n.a.	**16.9**	12
96-06-16	n.a.	<0,1	**0.2**	<0,2	n.a.	**18.2**	6
96-06-23	n.a.	<0,1	**0.2**	<0,2	n.a.	**8.7**	5
96-06-30	n.a.	**0.1**	**3**	<0,2	n.a.	**45.6**	2
96-07-07	<0,2	**0.3**	**6**	<0,2	n.a.	**16.5**	3
96-07-14	<0,2	<0,1	**3**	<0,2	n.a.	**8.7**	3
96-07-21	<0,2	**(0.05)**	**2**	<0,2	n.a.	**7.9**	1
96-07-28	<0,2	**(0.05)**	**3**	<0,2	n.a.	**7.7**	1
96-08-04	<0,2	**(0.05)**	**2**	<0,2	n.a.	**42.7**	0.3
96-09-07							
96-09-14	<0,2	**(0.05)**	**3**	<0,4	n.a.	**7.2**	1
96-09-22							
96-09-29	<0,2	**0.1**	**1**	<0,2	n.a.	**3.9**	1
96-10-06	<0,2	**0.2**	**4**	<0,2	n.a.	**6.7**	2
96-10-27							
96-11-03	**0.8**	**0.2**	**3**	<0.3	n.a.	**18.3**	2
96-11-10	**0.7**	**0.2**	**2**	<0.3	n.a.	**17.1**	3
96-11-17	**0.2**	<0,1	**2**	<0,4	n.a.	**8.0**	4
96-11-24	**(0.1)**	<0,1	**1**	<0,4	n.a.	**6.5**	10
96-12-01	<0.2	<0,1	**0.5**	<0,4	n.a.	**2.1**	30

Appendix 8. Monthly time weighted mean concentrations (TWMC) at site UT10 during May-November 1995 and 1996

	TWMC (µg/l) 1995 at UT10							TWMC (µg/l) 1996 at UT10						
Substance	May	Jun	Jul	Aug	Sep	Oct	Nov	May	Jun	Jul	Aug	Sep	Oct	Nov
atrazine	0.03	0.03	0.02	-	0.14	0.07	0.05	0.20	0.07	0.33	-	0.18	0.38	0.26
atrazine-desethyl	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.05	0.03
BAM	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00
benazolin-ethylester	0.04	0.07	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00
bentazone	0.03	0.04	0.00	-	0.26	0.23	0.35	0.04	0.33	0.45	-	0.05	0.13	0.17
chloridazon	0.05	0.21	0.00	-	0.00	0.00	0.00	0.00	0.21	0.00	-	0.00	0.00	0.00
clopyralid	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00
cyanazine	0.04	0.05	0.04	-	0.10	0.01	0.00	0.00	0.09	0.00	-	0.00	0.00	0.00
cyfluthrin	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.48	-	0.42	0.00	0.00
2,4-D	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.02	-	0.02	0.00	0.00
deltamethrin	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00
dichlobenil	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00
dichlorprop	0.02	0.00	0.00	-	0.07	0.00	0.00	0.16	9.87	0.86	-	0.36	0.20	0.03
diflufenican	n.a.	n.a.	n.a.	-	n.a.	n.a.	n.a.	n.a.	n.a.	0.10	-	0.09	0.18	0.17
dimethoate	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	2.90	-	0.00	0.00	0.00
diuron	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.01	-	0.15	0.05	0.00
esfenvalerate	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00
ethofumesate	0.09	0.46	0.07	-	0.16	0.03	0.05	0.07	0.09	0.11	-	0.15	0.15	0.07
fenpropimorph	0.00	0.12	0.14	-	0.10	0.01	0.01	0.07	0.08	0.41	-	0.25	0.15	0.06
flamprop-M	0.00	n.a.	n.a.	-	n.a.	n.a.	n.a.	n.a.	0.00	0.00	-	0.00	0.00	0.00
fluroxypyr	0.00	n.a.	n.a.	-	n.a.	n.a.	n.a.	0.00	1.31	1.09	-	0.19	0.18	1.00
hexazinon	0.00	0.00	0.00	-	0.05	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00
isoproturon	0.00	0.00	0.00	-	0.31	0.80	3.41	0.22	0.17	0.19	-	0.16	4.71	4.87
lambda-cyhalothrin	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00
linuron	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00
MCPA	0.22	0.12	0.00	-	0.00	0.00	0.00	0.14	3.02	0.45	-	0.10	0.07	0.01
mecoprop	1.06	1.22	0.03	-	0.11	1.05	1.80	0.33	4.24	0.50	-	0.10	0.51	0.44
metamitron	0.85	2.13	0.00	-	0.00	0.00	0.00	0.23	0.30	0.00	-	0.00	0.00	0.00
metazachlor	0.12	0.15	0.16	-	24.69	0.99	0.78	0.22	0.19	0.32	-	0.11	0.30	0.15
methabenzthiazuron	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00
phenmedipham	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00
pirimicarb	0.00	0.00	0.00	-	0.09	0.01	0.00	0.00	0.01	0.12	-	0.24	0.20	0.07
prochloraz	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00
propiconazole	0.00	0.02	0.08	-	0.62	0.10	0.06	0.07	0.17	1.55	-	0.83	0.60	0.34
propyzamide	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00
prosulfocarb	n.a.	n.a.	n.a.	-	n.a.	n.a.	n.a.	n.a.	n.a.	0.00	-	0.00	0.36	0.31
simazine	0.00	0.00	0.00	-	0.08	0.00	0.00	0.00	0.02	0.10	-	0.08	0.20	0.07
terbuthylazine	0.58	0.67	0.58	-	2.48	0.63	0.52	0.26	0.93	3.35	-	2.13	3.55	1.57
triadimenol	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00
tribenuron-methyl	n.a.	n.a.	n.a.	-	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-	n.a.	n.a.	n.a.
Sum pest	3.14	5.28	1.12	-	29.25	3.91	7.02	2.00	21.11	13.34	-	5.61	11.97	9.60

n.a. = not analysed

Appendix 9. Transported quantities and loss as percentage of applied amounts at UT10 1995-1996

Date	atrazine	atrazine-desethyl	BAM	benazolinethylester	bentazone	chloridazon	clopyralid
Transp (g)							
1995							
May	1.9	0.0	0.0	0.0	0.8	0.0	0.0
Jun	2.7	0.0	0.0	4.7	3.8	14.2	0.0
Jul	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Aug	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Sep	0.6	0.0	0.0	0.0	1.2	0.0	0.0
May-Sep	**5.3**	0.0	0.0	**4.7**	**5.7**	**14.2**	0.0
Oct	0.1	0.0	0.0	0.0	0.2	0.0	0.0
Nov	0.6	0.0	0.0	0.0	4.3	0.0	0.0
Oct-Nov	**0.7**	0.0	0.0	0.0	**4.5**	0.0	0.0
May-Nov	**6.0**	0.0	0.0	**4.7**	**10.3**	**14.2**	0.0
1996							
May	21.2	0.0	0.0	0.0	1.0	0.0	0.0
Jun	0.9	0.0	0.0	0.0	2.7	1.7	0.0
Jul	2.4	0.0	0.0	0.0	2.8	0.0	0.0
Aug	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Sep	0.2	0.0	0.0	0.0	0.1	0.0	0.0
May-Sep	**24.7**	0.0	0.0	0.0	**6.6**	**1.7**	0.0
Oct	0.2	0.0	0.0	0.0	0.1	0.0	0.0
Nov	3.4	0.3	0.0	0.0	4.0	0.0	0.0
Oct-Nov	**3.6**	**0.3**	0.0	0.0	**4.1**	0.0	0.0
May-Nov	**28.3**	**0.3**	0.0	0.0	**10.6**	**1.7**	0.0
Applied (kg)							
1995							
Spring	f.y.	-	-	0	0	59.2	0.2
Autumn	0	-	-	0	0	0	0
1996							
Spring	f.y.	-	-	0	8.6	8.7	0.8
Autumn	0	-	-	0	0	0	0
Loss (%)							
1995							
May-Sep				n.u.	n.u.	0.02%	0.00%
May-Nov						0.02%	0.00%
Oct-Nov				n.u.	n.u.		
1996							
May-Sep				n.u.	0.08%	0.02%	0.00%
May-Nov					0.12%	0.02%	0.00%
Oct-Nov				n.u.			
Average loss							
May-Sep					**0.08%**	**0.02%**	0.00%

n.u. = not used; f.y. = farm yard; n.a. = not analysed; - = metabolite

Appendix 9. Transported quantities and loss as percentage of applied amounts at UT10 1995-1996

Date	cyanazine	cyfluthrin	2,4-D	deltamethrin	dichlobenil	dichlorprop	diflufenican	dimethoate	diuron
Transp (g)									
1995									
May	1.0	0.0	0.0	0.0	0.0	1.0	n.a.	0.0	0.0
Jun	4.4	0.0	0.0	0.0	0.0	0.0	n.a.	0.0	0.0
Jul	0.3	0.0	0.0	0.0	0.0	0.0	n.a.	0.0	0.0
Aug	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Sep	0.4	0.0	0.0	0.0	0.0	0.3	n.a.	0.0	0.0
May-Sep	**6.1**	0.0	0.0	0.0	0.0	**1.2**	n.a.	0.0	0.0
Oct	0.0	0.0	0.0	0.0	0.0	0.0	n.a.	0.0	0.0
Nov	0.0	0.0	0.0	0.0	0.0	0.0	n.a.	0.0	0.0
Oct-Nov	0.0	0.0	0.0	0.0	0.0	0.0	n.a.	0.0	0.0
May-Nov	**6.1**	0.0	0.0	0.0	0.0	**1.2**	n.a.	0.0	0.0
1996									
May	0.0	0.0	0.0	0.0	0.0	15.5	n.a.	0.0	0.0
Jun	0.6	0.0	0.0	0.0	0.0	143.5	n.a.	0.0	0.0
Jul	0.0	0.8	0.1	0.0	0.0	6.1	0.5	4.6	0.0
Aug	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Sep	0.0	0.5	0.0	0.0	0.0	0.5	0.1	0.0	0.2
May-Sep	**0.6**	**1.3**	**0.1**	0.0	0.0	**165.6**	**0.6**	**4.6**	**0.2**
Oct	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.1
Nov	0.0	0.0	0.0	0.0	0.0	0.3	3.4	0.0	0.0
Oct-Nov	0.0	0.0	0.0	0.0	0.0	**0.5**	**3.5**	0.0	**0.1**
May-Nov	**0.6**	**1.3**	**0.1**	0.0	0.0	**166.2**	**4.1**	**4.6**	**0.3**
Applied (kg)									
1995									
Spring	f.y.	0.3	0	0	f.y.	13.2	0	0	0
Autumn	0	0	0	0	0	0	22.6	0	0
1996									
Spring	0	0.5	0	0.4	f.y.	29.4	0	0	0
Autumn	0	0	0	0	0	0	17.4	0	0
Loss (%)									
1995									
May-Sep		0.00%	n.u.	n.u.		0.01%	n.a.	n.u.	n.u.
May-Nov		0.00%				0.01%			
Oct-Nov			n.u.	n.u.			n.a.	n.u.	n.u.
1996									
May-Sep	n.u.	0.26%	n.u.	0.00%		0.56%	n.u.	n.u.	n.u.
May-Nov		0.26%		0.00%		0.57%			
Oct-Nov	n.u.		n.u.				0.02%	n.u.	n.u.
Average loss									
May-Sep		**0.13%**		0.00%		**0.29%**			

Appendix 9. Transported quantities and loss as percentage of applied amounts at UT10 1995-1996

Date	esfenvalerate	ethofumesate	fenpropimorph	flamprop-M	fluroxypyr	hexazinon	isoproturon
Transp (g)							
1995							
May	0.0	1.4	0.0	0.0	0.0	0.0	0.0
Jun	0.0	36.5	4.5	0.0	0.0	0.0	0.0
Jul	0.0	0.4	0.4	n.a.	n.a.	0.0	0.0
Aug	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Sep	0.0	0.7	0.4	n.a.	n.a.	0.2	1.2
May-Sep	0.0	**39.0**	**5.3**	0.0	0.0	**0.2**	**1.2**
Oct	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0
Nov	0.0	0.7	0.2	n.a.	n.a.	0.0	43.1
Oct-Nov	0.0	**0.7**	**0.2**	n.a.	n.a.	0.0	**43.1**
May-Nov	0.0	**39.7**	**5.5**	n.a.	n.a.	**0.2**	**44.4**
1996							
May	0.0	5.0	1.5	0.0	0.0	0.0	14.1
Jun	0.0	1.1	1.2	0.0	9.0	0.0	2.6
Jul	0.0	0.5	2.4	0.0	6.0	0.0	1.1
Aug	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Sep	0.0	0.2	0.3	0.0	0.3	0.0	0.2
May-Sep	0.0	**6.9**	**5.4**	0.0	**15.2**	0.0	**18.1**
Oct	0.0	0.1	0.2	0.0	0.0	0.0	0.3
Nov	0.0	0.5	0.7	0.0	22.8	0.0	64.2
Oct-Nov	0.0	**0.7**	**0.9**	0.0	**22.8**	0.0	**64.5**
May-Nov	0.0	**7.5**	**6.3**	0.0	**38.0**	0.0	**82.5**
Applied (kg)							
1995							
Spring	0.6	32.7	52.3	0	5.9	0	21.9
Autumn	0	0	0	0	0	0	219.8
1996							
Spring	2.6	15.3	142.4	0	20.3	0	0
Autumn	0	0	0	0	0	0	185.3
Loss (%)							
1995							
May-Sep	0.00%	0.12%	0.01%	n.u.	n.a.	n.u.	0.01%
May-Nov	0.00%	0.12%	0.01%				
Oct-Nov				n.u.		n.u.	0.02%
1996							
May-Sep	0.00%	0.04%	0.004%	n.u.	0.08%	n.u.	n.u.
May-Nov	0.00%	0.05%	0.004%		0.19%		
Oct-Nov				n.u.		n.u.	0.03%
Average loss							
May-Sep	0.00%	**0.08%**	**0.007%**		**0.08%**		**0.01%**

Appendix 9. Transported quantities and loss as percentage of applied amounts at UT10 1995-1996

Date	l-cyhalotrin	linuron	MCPA	mecoprop	metamitron	metazachlor	methabenzthiazuron
Transp (g)							
1995							
May	0.0	0.0	8.6	17.7	16.0	6.5	0.0
Jun	0.0	0.0	8.5	84.5	155.1	9.8	0.0
Jul	0.0	0.0	0.0	0.1	0.0	0.8	0.0
Aug	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Sep	0.0	0.0	0.0	0.5	0.0	88.4	0.0
May-Sep	0.0	0.0	**17.2**	**104.4**	**171.1**	**106.4**	0.0
Oct	0.0	0.0	0.0	0.1	0.0	1.1	0.0
Nov	0.0	0.0	0.0	24.1	0.0	9.7	0.0
Oct-Nov	0.0	0.0	0.0	**24.2**	0.0	**10.8**	0.0
May-Nov	0.0	0.0	**17.2**	**128.6**	**171.1**	**117.2**	0.0
1996							
May	0.0	0.0	14.6	22.5	5.0	18.2	0.0
Jun	0.0	0.0	51.2	57.7	2.5	2.4	0.0
Jul	0.0	0.0	3.3	3.7	0.0	1.5	0.0
Aug	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Sep	0.0	0.0	0.1	0.1	0.0	0.1	0.0
May-Sep	0.0	0.0	**69.2**	**84.0**	**7.5**	**22.2**	0.0
Oct	0.0	0.0	0.1	0.1	0.0	0.3	0.0
Nov	0.0	0.0	0.1	4.7	0.0	1.1	0.0
Oct-Nov	0.0	0.0	**0.1**	**4.8**	0.0	**1.4**	0.0
May-Nov	0.0	0.0	**69.4**	**88.8**	**7.5**	**23.7**	0.0
Applied (kg)							
1995							
Spring	1.1	0	28.4	91.3	317.1	0	3.9
Autumn	0.1	0	0	69.7	0	126.9	0
1996							
Spring	1.7	0	79.0	32.3	142.6	0	0
Autumn	0	0	0	0	0	13.0	0
Loss (%)							
1995							
May-Sep	0.00%	n.u.	0.06%	0.11%	0.05%	n.u.	0.00%
May-Nov			0.06%		0.05%		0.00%
Oct-Nov	0.00%	n.u.		0.03%		0.08%*	
1996							
May-Sep	0.00%	n.u.	0.09%	0.26%	0.01%	n.u.	n.u.
May-Nov	0.00%		0.09%	0.28%	0.01%		
Oct-Nov		n.u.				0.01%	n.u.
Average loss							
May-Sep	0.00%		**0.07%**	**0.19%**	**0.03%**		0.00%

* = Loss calculated for Sep-Nov

Appendix 9. Transported quantities and loss as percentage of applied amounts at UT10 1995-1996

Date	phenmedipham	pirimicarb	prochloraz	propiconazole	propyzamide	prosulfocarb	simazine
Transp (g)							
1995							
May	0.0	0.0	0.0	0.0	0.0	n.a.	0.0
Jun	0.0	0.0	0.0	0.5	0.0	n.a.	0.0
Jul	0.0	0.0	0.0	0.4	0.0	n.a.	0.0
Aug	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Sep	0.0	0.4	0.0	2.6	0.0	n.a.	0.3
May-Sep	0.0	**0.4**	0.0	**3.6**	0.0	n.a.	**0.3**
Oct	0.0	0.0	0.0	0.1	0.0	n.a.	0.0
Nov	0.0	0.0	0.0	0.8	0.0	n.a.	0.0
Oct-Nov	0.0	0.0	0.0	**0.9**	0.0	n.a.	0.0
May-Nov	0.0	**0.4**	0.0	**4.5**	0.0	n.a.	**0.3**
1996							
May	0.0	0.0	0.0	5.5	0.0	n.a.	0.0
Jun	0.0	0.1	0.0	1.8	0.0	n.a.	0.1
Jul	0.0	0.3	0.0	6.3	0.0	0.0	0.6
Aug	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Sep	0.0	0.3	0.0	1.0	0.0	0.0	0.1
May-Sep	0.0	**0.7**	0.0	**14.6**	0.0	0.0	**0.9**
Oct	0.0	0.2	0.0	0.6	0.0	0.0	0.2
Nov	0.0	0.5	0.0	5.3	0.0	3.1	0.5
Oct-Nov	0.0	**0.8**	0.0	**5.9**	0.0	**3.1**	**0.8**
May-Nov	0.0	**1.5**	0.0	**20.5**	0.0	**3.1**	**1.6**
Applied (kg)							
1995							
Spring	62.5	2.6	0	17.4	0	0	0
Autumn	0	0	0	0	0	40.8	0
1996							
Spring	28.4	9.4	0	49.6	0	0	0
Autumn	0	0	0	0	0	0	0
Loss (%)							
1995							
May-Sep	0.00%	0.01%	n.u.	0.02%	n.u.	n.a.	n.u.
May-Nov	0.00%	0.01%		0.03%			
Oct-Nov			n.u.		n.u.	n.a.	n.u.
1996							
May-Sep	0.00%	0.01%	n.u.	0.03%	n.u.	n.u.	n.u.
May-Nov	0.00%	0.02%		0.04%			
Oct-Nov			n.u.		n.u.	n.u.	n.u.
Average loss							
May-Sep	0.00%	**0.01%**		**0.02%**			

Appendix 9. Transported quantities and loss as percentage of applied amounts at UT10 1995-1996

Date	terbuthylazine	triadimenol	tribenuron-methyl	Sum pest	Av. flow (l/s)
Transp (g)					
1995					
May	32.4	0.0	0.1	87.5	23
Jun	53.3	0.0	n.a.	382.4	25
Jul	3.5	0.0	n.a.	6.2	3
Aug	n.a.	n.a.	n.a.	n.a.	0.4
Sep	10.2	0.0	0.0	107.2	2
May-Sep	**100.3**	0.0	**0.1**	**586.8**	**11**
Oct	0.7	0.0	n.a.	2.3	1
Nov	6.8	0.0	n.a.	90.2	5
Oct-Nov	**7.4**	0.0	n.a.	**92.5**	**3**
May-Nov	**107.7**	0.0	n.a.	**679.3**	**9**
1996					
May	21.8	0.0	n.a.	145.9	27
Jun	7.8	0.0	n.a.	286.8	7
Jul	19.9	0.0	n.a.	63.0	2
Aug	n.a.	n.a.	n.a.	n.a.	0.2
Sep	2.6	0.0	n.a.	6.9	0.7
May-Sep	**52.1**	0.0	n.a.	**502.6**	**7**
Oct	4.2	0.0	n.a.	7.1	0.7
Nov	25.9	0.0	n.a.	140.9	8
Oct-Nov	**30.1**	0.0	n.a.	**147.9**	**5**
May-Nov	**82.2**	0.0	n.a.	**650.5**	**7**
Applied (kg)					
1995					
Spring	f.y.	0	2.0	712.6	
Autumn	0	0	0	479.9	
1996					
Spring	f.y.	0.7	3.7	576.2	
Autumn	0	0	0	215.7	
Loss (%)					
1995					
May-Sep		n.u.	(0.01%)		
May-Nov					
Oct-Nov		n.u.	n.a.		
1996					
May-Sep		0.00%	n.a.		
May-Nov		0.00%			
Oct-Nov			n.a.		
Average loss					
May-Sep		0.00%			

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