Influence of different pesticides on Spider communities in a Riparian forest of the Rhine river

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INTRODUCTION

After the Sandoz accident (Basel, Switzerland) in 1986 there was no knowledge about the possible influence of the released pesticides on soil-inhabiting invertebrates in case of highwater during the accident.
Therefore the soil-inhabiting populations in 6 riparian forests along the Rhine river from Basel to Mannheim were studied comparatively (GefaÖ 1990).
In a second step different pesticides were applied on small areas in one of these forests in order to simulate an accident. The following groups of invertebrates were inspected: Araneae, Isopoda, Carabidae, Staphylinidae, other Coleoptera, Diptera, Ichneumonidae, insect-larvae and earthworms.

In this paper the reaction of spider populations to the chemical irritations are demonstrated, especially the changes of the population dynamics of some species.

METHOD

One area of 25 m^2 was treated with deltamethrin (0,01 g; plot A), a second (25 m^2) with uncontaminated water (plot B) and a third one (plot C, 25 m^2) with a mixture of 5 different pesticides (atrazin 2,4 g; parathion 0,35 g; pirimicarb 0,75 g; lindan 0,48 g; deltamethrin 0,01 g). The plots were situated neighbouring, with plot B being the middle one. The application of chemicals was performed in June 1989 using a hand sprayer ("Mesto 3600 5 l"). After contamination each plot was watered with 20l of tap water with a sprinkling can.
Then 8 ground-photoeclectors were installed randomly (diameter 0,6 m) in each plot. The ground-photoeclectors had a pitfall trap and a trap at the top (=topbox).

The traps were emptied 4 and 10 weeks after contamination.

RESULTS

Within 10 weeks, 3650 individuals of spiders consisting of 28 species were collected.

Tab. 1 shows which species were sampled with the different traps. In Fig. 1 the number of species in the different plots at both sampling times is demonstrated.

Family/species	pitfall trap		topbox	
	1	2	1	2
• Family CLUBIONIDAE				
Clubiona lutescens	-	x	x	x
• Family SALTICIDAE				
Salticus cingulatus	-	-	x	-
• Family LYCOSIDAE				
Pirata piraticus	x	x	x	x
• Family THERIDIIDAE				
Robertus lividus	-	-	-	x
• Family METIDAE				
Pachygnatha clercki	-	x	x	x
Pachygnatha listeri	-	-	x	x
• Family LINYPHIIDAE				
Allomengea vidua	-	x	-	x
Bathyphantes approximatus	x	x	-	x
Bathyphantes gracilis	x	x	x	x
Bathyphantes nigrinus	-	x	-	x
Centromerus aequalis	-	-	-	x
Centromerus sylvaticus	x	-	-	-
Diplocephalus picinus	-	-	-	x
Diplostyla concolor	x	x	x	x
Entelecara erythropus	-	x	x	x
Erigone atra	-	-	x	-
Gnathonarium dentatum	x	x	x	x
Gongylidiellum murcidum	-	-	x	x
Gongylidium rufipes	-	-	x	x
Lepthyphantes flavipes	-	-	x	-
Lepthyphantes tenuis	x	x	x	x
Leptorhoptrum robustum	-	x	-	x
Micrargus herbigradus	-	-	-	x
Oedothorax apicatus	x	x	x	x
Oedothorax fuscus	-	x	x	x
Oedothorax retusus	-	-	-	x
Porrhomma pygmaeum	x	x	x	x
Walckenaeria nudipalpis	x	x	x	x

Tab. 1: The collected species of spiders separated for pitfall traps and topboxes. 1 = sampling after 4 weeks; 2 = sampling after 10 weeks

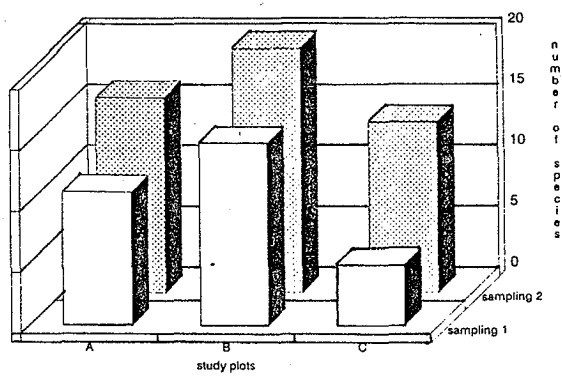

Fig. 1: Number of the species collected with the ground-photoeclectors. A, B, C = study plots
sampling 1 = after 4 weeks, sampling 2 = after 10 weeks

The most species were found in the control area (B) at both sampling times. After 10 weeks the number of species in all study areas was increased compared to the first sampling (4 weeks after contamination). This increase was highest in the plot C, but the number of species of both contaminated plots did not reached the control.
Similary results have been reported by Platen (1988). In this fieldstudy the number of spiders were reduced after contamination with Na-PCP.

The number of individuals in the pitfall traps was nearly the same in all study plots (Fig. 2).

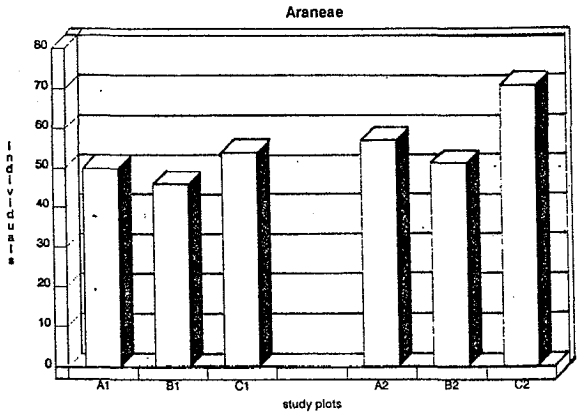

Fig. 2: Number of individuals collected with pitfall traps
A, B, C = study plots; 1 = after 4 weeks; 2 = after 10 weeks

Most of the individuals have been collected in the topboxes (Tab. 2 and Fig. 3). After 10 weeks the number of individuals was much more higher then after 4 weeks. The reasons for this strong increase of the number of individuals are probably the optimal time of development and the better microclimate situation within the eclectors. In addition the spiders were possibly urged to leave the litter while the ground water increased during a slight highwater.

species	sampling 1			sampling 2		
	A	B	C	A	B	C
Allomengea vidua	-	-	-	2(0,001)	-	-
Bathyphantes approximatus	-	-	-	-	1(0,001)	-
Bathyphantes gracilis	71(0,38)	46(0,25)	5(0,23)	202(0,15)	108(0,07)	10(0,02)
Bathyphantes nigrinus	-	-	-	-	1(0,001)	-
Centromerus aequalis	-	-	-	-	1(0,001)	-
Diplocephalus picinus	-	-	-	-	-	1(0,002)
Diplostyla concolor	-	1(0,01)	-	14(0,01)	11(0,01)	4(0,01)
Entelecara erythropus	3(0,02)	2(0,01)	-	1(0,001)	4(0,003)	1(0,002)
Erigone atra	2(0,01)	5(0,03)	-	-	-	-
Gnathonarium dentatum	3(0,02)	8(0,04)	-	53(0,04)	59(0,04)	26(0,06)
Gongylidiellum murcidum	2(0,01)	-	-	3(0,002)	3(0,002)	1(0,002)
Gongylidium rufipes	-	1(0,01)	-	-	1(0,001)	1(0,002)
Lepthyphantes flavipes	3(0,02)	2(0,01)	-	-	-	-
Lepthyphantes tenuis	-	7(0,04)	2(0,09)	9(0,01)	1(0,001)	-
Leptorhoptrum robustum	-	-	-	-	3(0,002)	-
Micrargus subaequalis	-	-	-	1(0,001)	-	-
Oedothorax apicatus	2(0,01)	2(0,01)	1(0,05)	1(0,001)	-	10(0,02)
Oedothorax fuscus	2(0,01)	-	-	4(0,003)	3(0,002)	6(0,01)
Oedothorax retusus	-	-	-	8(0,01)	9(0,01)	-
Porrhomma pygmaeum	71(0,38)	30(0,16)	13(0,59)	380(0,28)	428(0,29)	222(0,54)
Walckenaeria nudipalpis	-	-	-	2(0,001)	1(0,001)	2(0,01)
Clubiona lutescens	2(0,01)	4(0,02)	1(0,05)	-	5(0,003)	3(0,01)
Clubiona sp. (juv)	-	2(0,01)	-	4(0,003)	10(0,01)	6(0,01)
Salticus cingulatus	-	1(0,01)	-	-	-	-
Pirata piraticus	3(0,02)	2(0,01)	-	-	1(0,001)	-
Robertus lividus	-	-	-	2(0,001)	1(0,001)	-
Pachygnatha clercki	-	1(0,01)	-	59(0,04)	29(0,02)	1(0,002)
Pachygnatha listeri	-	1(0,01)	-	2(0,001)	2(0,001)	7(0,02)
juvenil	24(0,13)	68(0,37)	-	633(0,46)	781(0,53)	113(0,27)
Total number	188	183	22	1380	1463	414

Tab. 2: Number of individuals and dominances (in parenthesis) collected with the topboxes

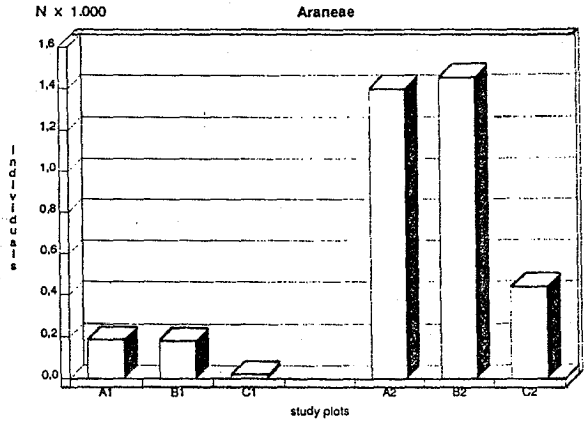

Fig. 3: Number of individuals collected with topboxes
Legend see Fig. 2

Only a very few individuals were found in area C, where the pesticides had great effect on the spider community. After 10 weeks the number of individuals in area C are still reduced. Delthamethrin showed only slight effects on the spider community.
The contamination with pesticides changed the dominances of some species (Tab. 2). After 4 weeks higher values were found for Bathyphantes gracilis and Porrhomma pygmaeum in the contaminated plots (A and C). After 10 weeks the value for Bathyphantes gracilis was still higher in area A, but in C the dominance value decreased again. After 10 weeks the dominance of Porrhomma pygmaeum had the same value again in A like in the control group, but in C it was still increased (Tab. 2).
In both contaminated plots the number of juveniles was reduced significantly at both sampling times compared to the control. After 4 weeks no juveniles were found in plot C.

After contamination the decrease of some species could be calculated with the T-test.

After 4 weeks plot C (mixture) compared to the control plot (B):

Bathyphantes gracilis	$P < 0,01$
Porrhomma pygmaeum	$P < 0,05$
Juveniles	$P < 0,001$

After 10 weeks C in comparison with B:

Bathyphantes gracilis	$P < 0,01$
Porrhomma pygmaeum	$P < 0,05$
Juveniles	$P < 0,001$
Gnathonarium dentatum	no significance

The comparison of the results between plots A and B gave no significance.
Oedothorax retusus and Pachygnatha clercki were remarkable decreased in plot C, but no statistically difference could be calculated

SUMMARY

Within 10 weeks, 3650 individuals of spiders consisting of 28 species were collected with 24 ground-photoeclectors.
Deltamethrin showed only slight effects on the spider populations but for two species changed dominance values were found. After contamination with a

mixture of different pesticides the number of individuals and species were reduced remarkably. Especially the species, which are living in the litter and the juveniles have been influenced by the chemicals.
The results show that spiders can be a well adapted group for testing chemicals in field studies (Dorn & Kolbe 1987, Albert et al. 1987, Schauermann 1987 and Platen 1988 a,b).

ZUSAMMENFASSUNG

Mit 24 Bodenphotoeklektoren wurden in 10 Wochen 28 Arten mit 3650 Individuen gesammelt.
Deltamethrin zeigte nur eine geringe Wirkung auf die Spinnenpopulationen, aber bei 2 Arten waren Veränderungen der Dominanzen zu erkennen. Nach Kontamination einer Mischung mit verschiedenen Pestizide war eine deutliche Abnahme der Arten- und Individuenzahlen zu beobachten.
Besonders die streulebenden Arten und die Juvenilen wurden durch die Chemikalien beeinflußt.
Die Ergebnisse zeigen, daß die Spinnen eine gut geeignete Tiergruppe für Chemikalientestungen im Freiland sind (Dorn & Kolbe 1987, Albert et al. 1987, Schauermann 1987 and Platen 1988 a,b).

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